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Index to Advertisers and Classified Index Following Reading Matter.

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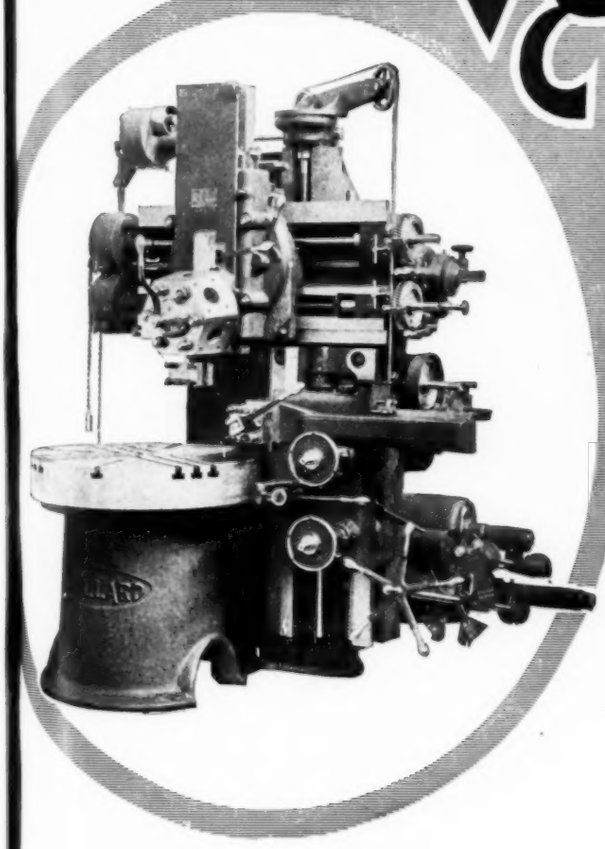

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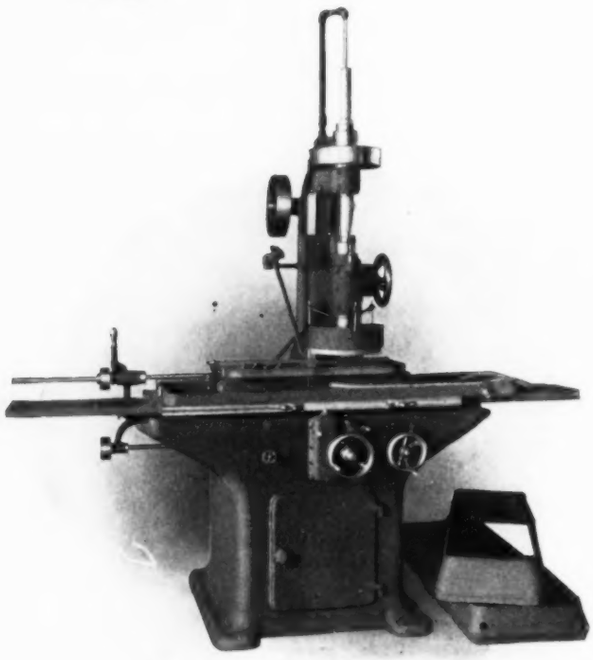

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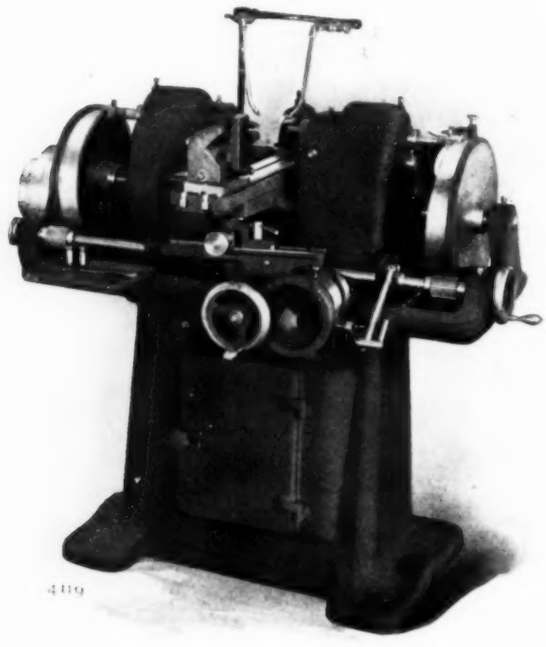

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A Large, Vertical, Cylinder Boring Machine

Equipped with Friction Drive, a Wide Range of Speeds and Feeds and Powerful Tools It Is an Excellent Example of a Special Design

BY PHILIP BELLOWS

It sometimes happens that an engineering concern finds itself confronted with a piece of work for which none of the machines in its shops is fitted, and moreover, for which no machine on the market is suitable. Under such conditions it remains for the management to consider whether the job is worth the expense of a special machine or not. Recently the task of casting and boring some cylinders of exceptional size presented such a problem to an Eastern shop. It was decided that a special machine would have to be built to do the work properly, and the subject of this article was the outcome.

Designs were prepared for a machine having a friction drive as a basis of operation, and a number of prominent machine-tool firms were invited to estimate on these designs. As the estimates submitted were all considered to be higher than the cost of a home-built product, it was decided to make the whole machine on the spot.

As there are many points of special interest in the machine, I will describe in detail some of its more important features for the benefit of those who are particularly interested in the subject of friction drive as applied to large machine tools. Fig. 1 shows the finished machine as it stands in the shop at the present time. The bed plate is a one-piece iron casting 18 feet long, 9 feet 4 inches wide, and 10 inches deep; amply slotted for holding bolts for U-plates. The uprights which support the cross-rail are each 46x66 inches over flanges at the base, where the latter bolts to the bed plate, and taper toward the top to 34 inches by approximately 46 inches over the flanges. The cross-rail is bolted to the tops of these uprights, and is set without being adjustable. It is of box section 24 inches deep by approximately 36 inches wide. The clear space between the uprights is 10 feet; vertically the clear hight is 10 feet 11½ inches. Thus it will be seen that a very large and heavy casting can be gotten into the machine, especially if the part to be operated on is narrower than the rest of the casting. The bed plate is flush with the concrete floor, thus making it easy to set any unusually large and irregular piece in the machine.

The Friction Drive

Figs. 1 and 2 show the machine from diametrically opposed corners; the first is a view of the operating side and the second shows the rack for the boring bars. It will be noticed that the motor is housed in the hollow base of the nearer upright of Fig. 1. This is a 15-horsepower motor arranged to run in either direction, and its normal speed is 720 revolutions per minute. The switchboard with switch and controller is seen behind the motor and outside of the upright (see Fig. 2).

Coupled directly to the motor shaft is the shaft which carries the main friction wheel. The latter has a working face 12 inches in diameter by 2½ inches wide, and is crowned about ⅜ inch higher in the middle than at the sides. The construction of this part of the machine is plainly shown in Fig. 3. The friction wheel is composed of fiber disks about ¼ inch thick; my impression is that these are of the ordinary type used for electrical insulation. These disks are firmly held between two cast-iron plates bolted together and held securely by six ½-inch through bolts. The hub, which is integral with one of the side plates, is bored a sliding fit to its shaft, and its rotation upon the latter is controlled by a feather splined in the shaft. The shaft is 2½ inches in diameter. A yoke fits over the shaft, as shown, and controls the side movement of the wheel, while the yoke is controlled by a square-threaded shaft, operated by a handwheel, so that the movement of the latter effects changes in the speed of the machine by changing the position of the friction wheel in relation to the center of the disk that it operates. A collar on the handwheel shaft acts as a stop to prevent the yoke from traversing the friction wheel past the center of the friction disk, and thus forcing the tool backward in its cut. The shaft of the friction wheel, after passing through a substantial bearing, carries an idler which is a counterpart of the friction wheel itself, and is for the purpose of balancing the thrust of the latter. It is made of the same material, and its diameter reduces at about the same rate as the driver. It is placed at the point of maximum velocity of the friction disk, and tends to compensate for the work done by the friction wheel as a factor in maintaining equal wear on each.

By reference to Fig. 1, it will be seen that an oil cup is provided for the idler bearing, set outside of the machine and the oil is piped to its point of application. This oiling is an important detail of design in all friction-driving arrangements; ample provision must be made for thorough lubrication owing to the high speeds generally prevailing in friction drives. Yet the oiling must be done with care to prevent its touching the friction surfaces.

Resting on the friction wheel and idler is the main friction disk, a cast-iron plate 36 inches in diameter and 1 inch thick on the rim with four ribs on top for strength. Here again the design shows good judgment, as the position of this disk not only protects its working face but also the friction wheel from any drops of oil falling from shafting or machinery above. By reference to Fig. 3 it will be seen how the pressure of this disk against its driver is regulated. A bronze bushing bored to fit the vertical shaft is provided with a square-threaded screw on its outer surface, where it fits into a thread in the supporting bracket. The lower end of this bushing is turned down and clamped firmly by the regulating handle so that horizontal movement of the latter causes vertical movement of the disk. A bronze friction ring is provided to assist in taking the thrust of the disk against the bushing. The regulating handle is secured by a notched sector plate. The shaft is 1¾ inches diameter and is of cold-rolled steel.

A point of interest to designers may be referred to here. As originally planned there was only one intermediate bearing located on the vertical shaft; namely, the one seen close to the platform strut in Fig. 1. It was reasoned, no doubt, that because the shaft was in a vertical position this bearing would be ample; there is apparently no tendency to buckle, as would be the case if the shaft were horizontal. When running at speed, however, it was noticed that the shaft whipped badly at a point about 2 feet above the disk; hence the bearing shown at that point.

At its upper end the shaft carries a cast-iron bevel gear with 24 teeth meshing with one having 31 teeth. The latter is fastened to a shaft, shown broken in Fig. 4, and in full in Fig. 5. Fig. 4 shows the arrangement of the driving gear, while Fig. 5 shows the feed arrangements. In the former it will be seen that after passing through a bearing this shaft carries a plain gear having 24 teeth and meshing with one having 108 teeth. The latter is formed on the socket of a large cone clutch, whose cone carries hardwood blocks set end grain outward around its circumference; it is 33 inches in outside diameter. This cone is feathered to its shaft with a sliding feather, and the clutch is controlled by a threaded rod passing through the shaft, which is hollow. This

rod is operated by a hand wheel on the far side of the machine. The rod and hand wheel are so fitted that while they can cause lateral motion of the clutch cone they do not revolve with it.

It should be clearly understood that at present I am describing the driving mechanism only; the feed will be taken up later; for the present all references are to Fig. 4 in conjunction with Figs. 1 and 2.

The clutch just described drives directly a bevel pinion with 15 teeth, which in turn drives a bevel with 46 teeth on a vertical shaft. Below the latter gear and coupled to it is a spur pinion with 29 teeth, operating a gear with 77 teeth. Fastened to the shaft of the latter, and just above it, is a spur pinion with 18 teeth meshing with the large gear, which is keyed to the head of the boring bar by a key 3 inches wide and 1¾ inches thick. This wheel has an outside diameter of 64.32 inches, 127 teeth of 2 diametral pitch and a face 7 inches wide. These figures will give some idea of the strength of the parts that do the cutting. The weight of the wheel cannot be much short of 2000 pounds. It rests on a race of ½-inch steel balls.

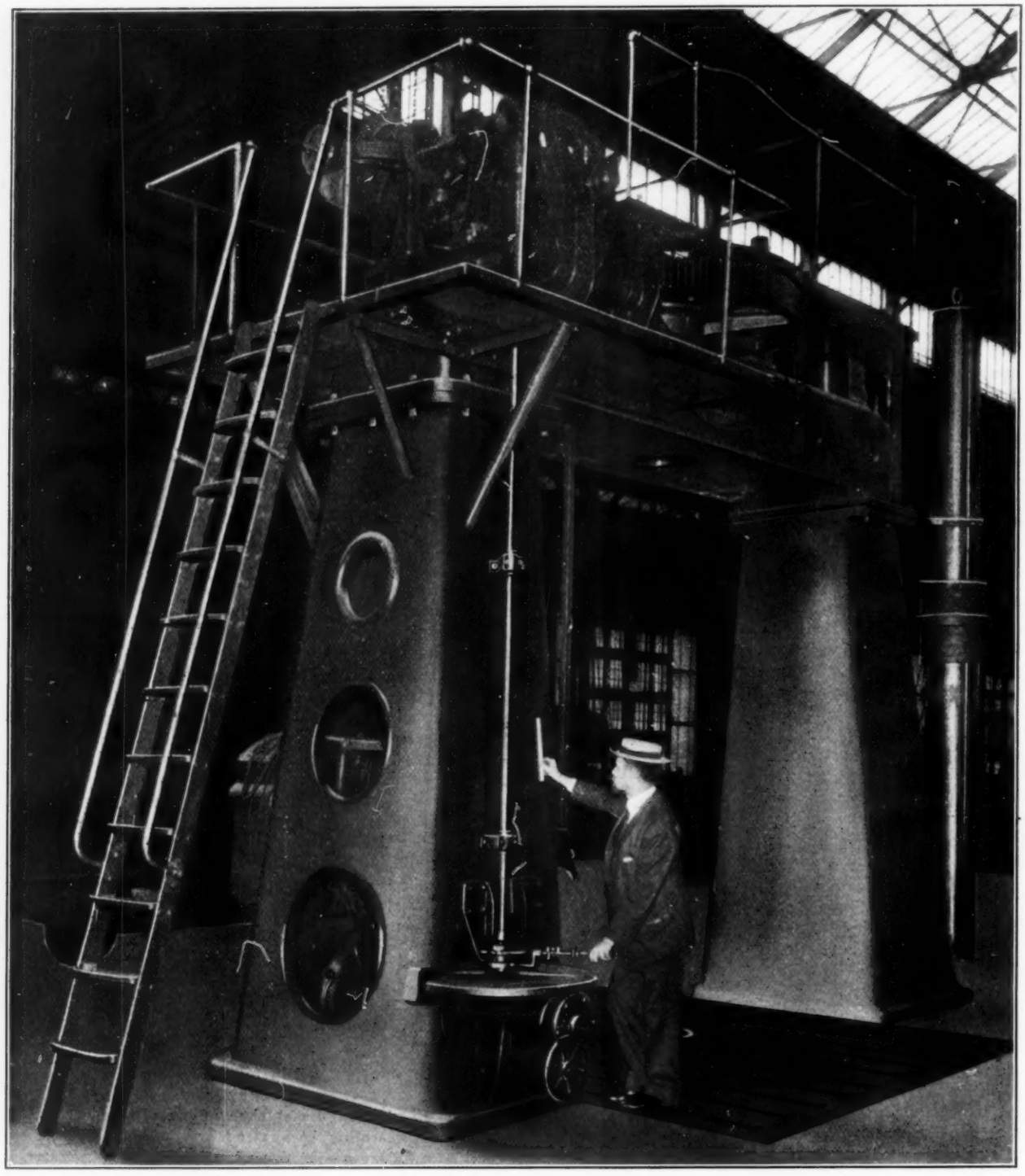


FIG. 1. LARGE CYLINDER BORING MACHINE, OPERATING END

The Boring Bars

There are three boring bars shown in the foreground in Fig. 2; they are respectively 14 inches, 10 inches and 6 inches diameter, with a length of approximately 15 feet 2 inches. Close to the tops of the two smaller bars will be seen the liners provided to fill up the bearings in the cross-rail and bed plate, which are

made to fit the 14-inch bar. These liners are made in the form of rings of a convenient thickness to permit of being handled by light hand tackle.

The Step Bearing for the Bars

Fig. 6 shows the step bearing. As in the case of the 14-inch bar, this has to support a weight in the bar alone of about 8000 pounds, and about 1000 pounds more with the large tool holder in place, it will be seen that caution had to be observed in the design of this part. Although the pressure of about 60 pounds per square inch is by no means excessive with adequate lubrication, yet there were practical difficulties connected with the oiling, which it was deemed advisable to overcome in another way. A ball bearing affords ample reservoir space between the balls for lubricant and consequently the form of bearing shown in Fig. 6 was adopted. It has given satisfaction. The bar rests upon a steel plate about ½ inch thick, hardened and ground to an even thickness, which in turn rests upon a large number of steel balls about ½ inch in diameter. These balls rest upon another plate, similar to the first, resting on the bottom of the bearing. Each plate is provided with a hole in the middle just large enough to insert a finger to lift it out.

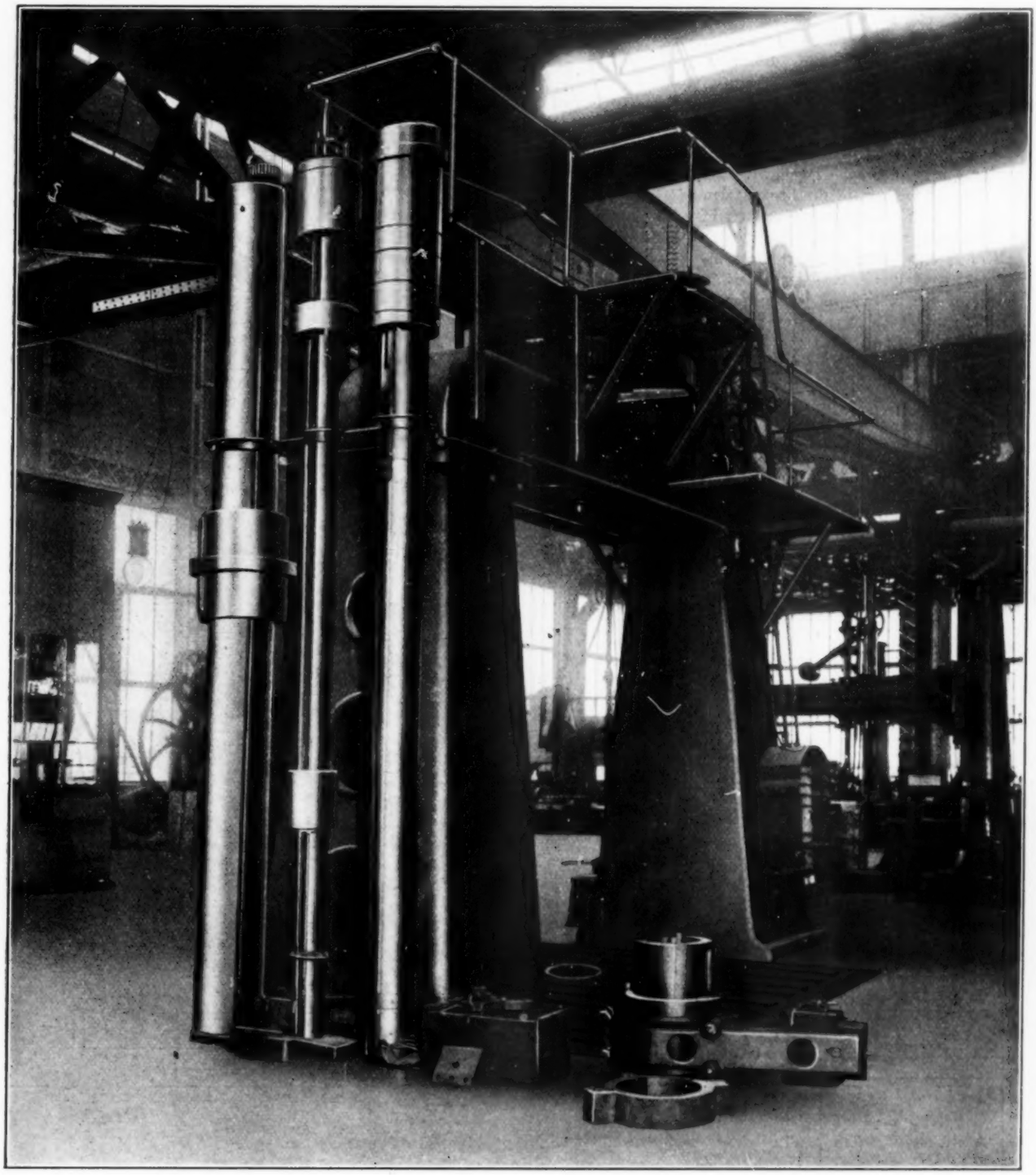


FIG. 2. LARGE CYLINDER BORING MACHINE, BORING BARS AND SWITCHBOARD

A Boring Head

Fig. 7 shows one of the large boring heads which can be used either for boring or facing the largest cylinders. It can be used for the former purpose when there is a diameter of about 5 feet 9 inches or

more to turn in, though it may be used to face areas down to about 2 feet in diameter. This tool can be seen in the foreground of Fig. 2, and as seen there it furnishes ample testimony to the power of the friction drive. It will be noted that the arm which is turned toward the upright of the machine is snapped off close to the holding bolts. The line of breakage is shown in Fig. 7, and Fig. 8 shows a section of the broken area. While operating the mill recently, the operator failed to notice that the outward end of the now broken arm could not move, owing to an immovable obstruction, and the break, as shown, was the result. If we regard the broken arm as a lever with the edge marked *C*, in Fig. 8, as its fulcrum we find that it took a pull of 210,000 pounds to part the combined areas *A* and *B*, taking the tensile strength of the casting as 30,000 pounds per square inch. As the greatest possible ratio of the long and short arms of this lever is not more than 2 to 1, it follows that the pressure exerted at the point of contact must have been well over 100,000 pounds as a minimum, and possibly double that amount if the obstruction was at a point closer to the break than the end of the arm. As it requires a pressure of

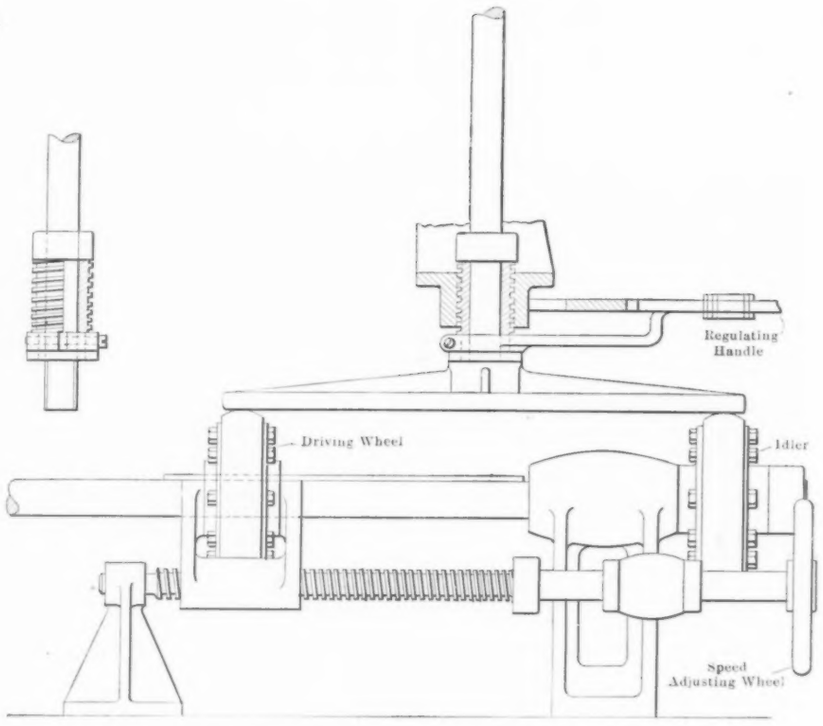


FIG. 3. THE FRICTION-DRIVING MECHANISM

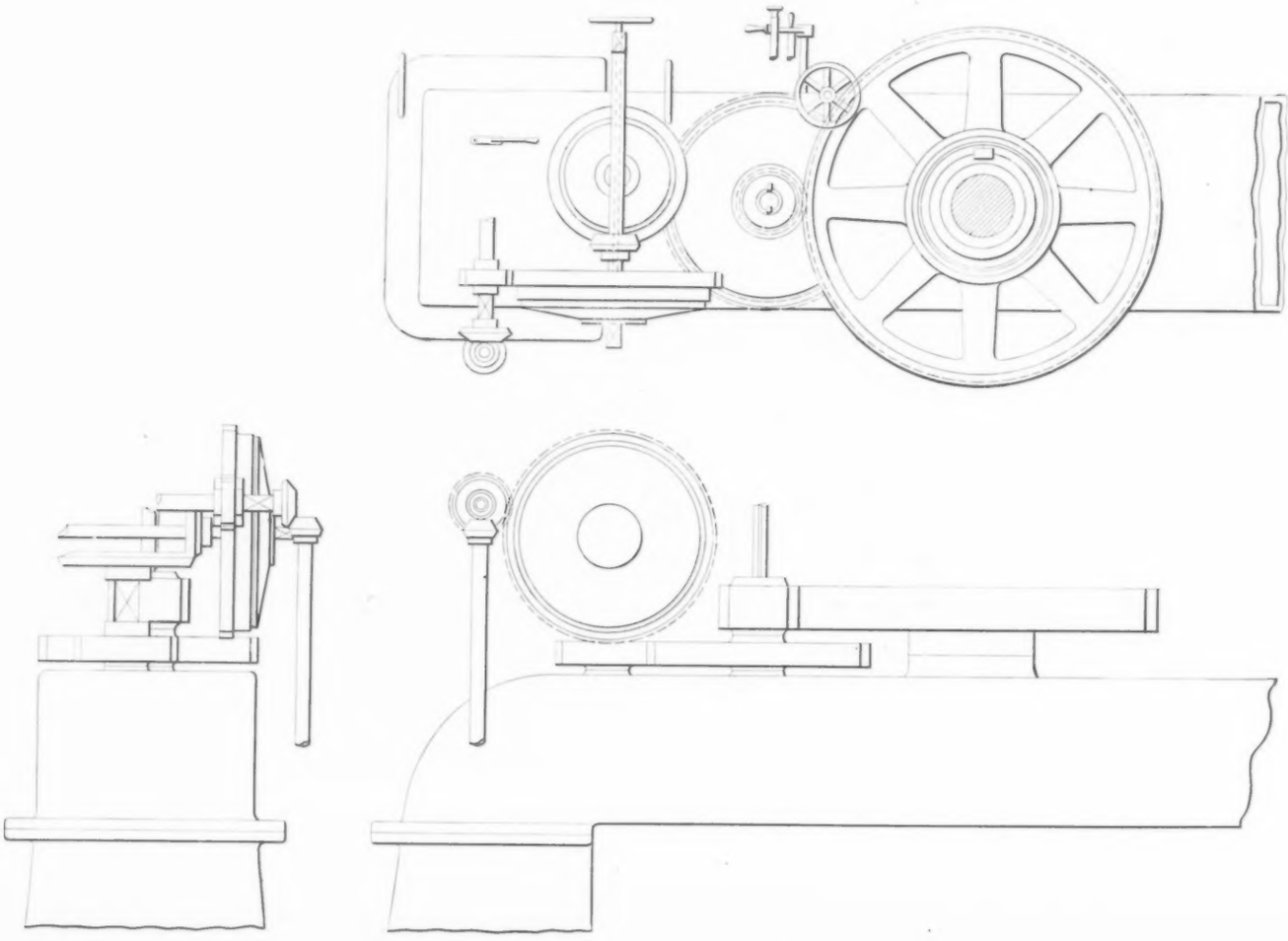


FIG. 4. THE TRANSMITTING MECHANISM OF THE DRIVE

about 80,000 pounds per square inch of section cut to remove ordinary cast iron with a good tool, some idea may be obtained of the ability of the machine to clean up, say, a 6-foot cylinder.

The broken arm of this head carries a

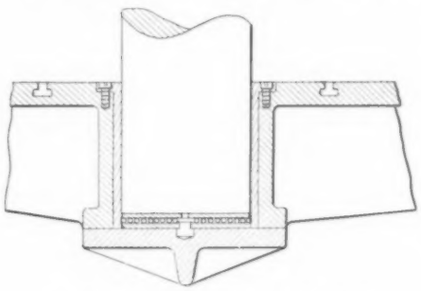


FIG. 6. BORING BAR STEP BEARING

short spindle suitably mounted, and fitted with a bronze bevel at its lower end meshing with a similar wheel on the horizontal traversing screw of the head. At its upper end this spindle has a squared portion designed to fit an extension socket which can be operated from above by a star wheel.

Fig. 9 shows a small head, which can be bolted to the upper edge of traveler shown attached to the boring head in Fig. 7. This tool is suitable for facing stuffing boxes, and other places where it is desirable to work close up to the boring bar. The traveler just referred to fits the bar and is caused to slide on it by the four bronze nuts fastened to the traveler; through these pass the two traversing screws; these nuts also act as sliding keys to prevent the traveler turning on the bar.

The total reduction at slow speed, that is, when the friction wheel is running at the edge of the disk, is about 1000 to 1. With the motor at 720 revolutions per minute, the speed of the bar will be 0.72 revolution per minute.

Feeding Mechanism

We will now consider the feed arrangements which have been worked out with considerable elaboration of detail. Referring to Figs. 1 and 5, it will be seen that the vertical shaft at the motor end operates a horizontal shaft at the top of the machine. This, besides carrying a small bevel and a spur pinion, carries a larger bevel with 25 teeth and a friction disk of 20 inches diameter. The larger bevel drives another with about 1/3 less teeth, which, in turn, operates a belt wheel 16 inches in diameter carrying a 2-inch belt. This, in turn, drives the 10-inch cup of a cone clutch. The function of this train is to operate the high-speed traverse when the tool is withdrawn at the end of a cut.

Going back to the 20-inch friction wheel, which is of cast iron, we find that this is a small duplicate of the one on the main drive and is regulated as to pressure in

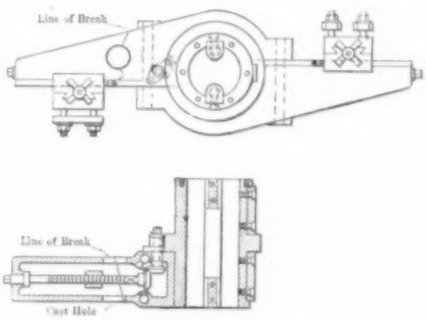


FIG. 7. A BORING HEAD

the same way. It would have been better, perhaps, if the arrangement here had been different, for, with the iron disk acting as a driver, in this case there is a liability to wear flat spots on the fiber wheel. The fiber wheel should always be the driver

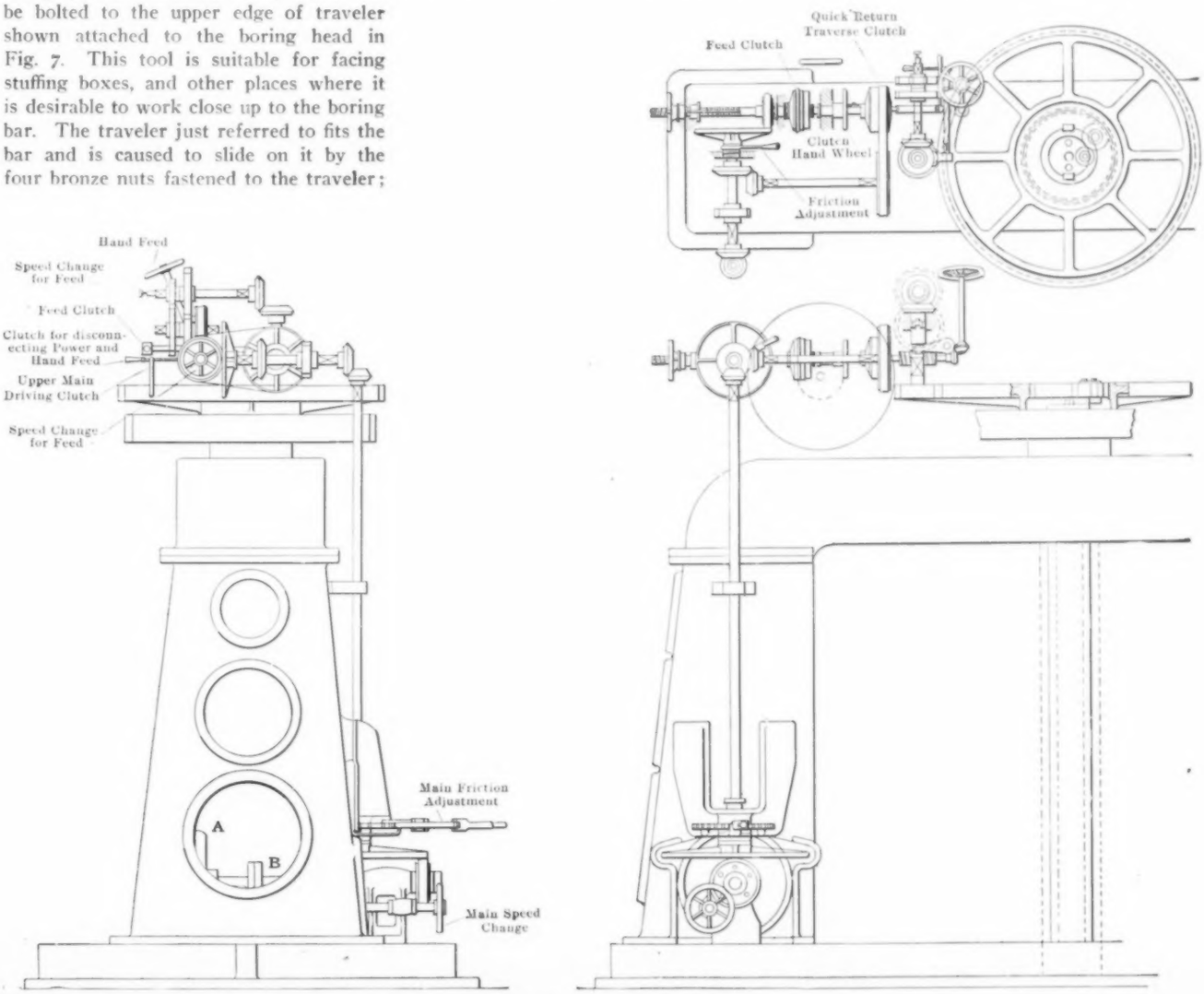


FIG. 5. GENERAL ASSEMBLY SHOWING DRIVING MECHANISM

to avoid this trouble. The form of pressure regulation used in the friction wheels is good; it gives positive pressure of a definite amount and does not tend to wear flats in the wheels as a spring pressure would do. The small friction disk drives a fiber wheel 10 inches in diameter by 1¾ inches face, keyed fast to a steel shaft. This shaft extends in both directions from the wheel. The free end passes into a bronze sleeve which is coupled to the friction wheel and regulates its speed in the manner shown clearly in Figs. 5 and

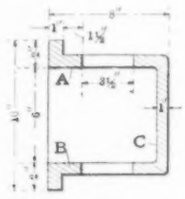
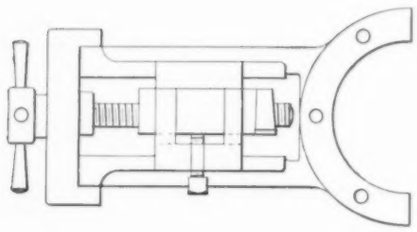


FIG. 8. SECTION OF BROKEN PART OF BORING HEAD



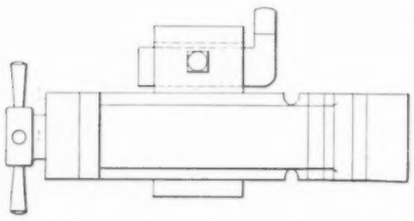


FIG. 9. AN AUXILIARY HEAD

10. The regulation of the speed of this wheel controls the amount of cut at the tool. Fig. 11 shows the kind of indicator used to show the feed. Following the steel shaft in the other direction past the friction wheel we find that after passing through a bearing it is fastened to the cup of a cone clutch. The cone of this clutch is keyed fast to the end of a steel shaft, at the other end of which is keyed the cone of the clutch driven by the belt before referred to. The two cones are controlled by a handwheel whose hub is internally a nut and externally fits a bear-

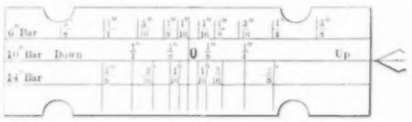


FIG. 11. THE FEED INDICATOR

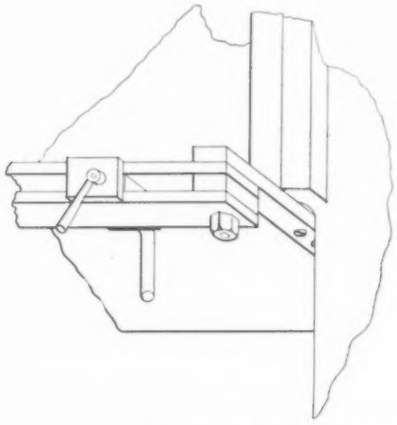
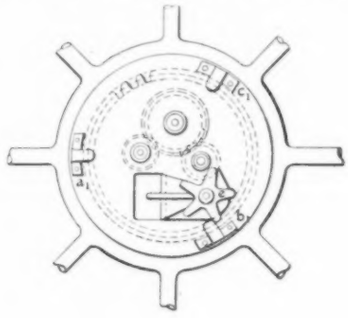


FIG. 12. CLAMP FOR TRIP FOR STAR-WHEEL FEED

ing. A bronze sleeve, having a thread, fits the nut and the sleeve and transmits lateral motion to the two cones. The thrust is taken by flanges on the hub of the handwheel. As shown in Figs. 5 and 10, the feed-change friction wheel is set to traverse the tool upward. If, however, it should be placed on the far half of the disk to cut downward, then the belt before referred to becomes inoperative, and reversing is done with the feed-change wheel. The cup driven by the belt, runs idle upon its shaft, but its cone transmits motion to this shaft by an extended internal hub and sliding feather, so that when the reversing gear is brought into operation the clutch next to the friction wheel is thrown out and the belt clutch then drives the shaft. Next to the belt-driven clutch is a worm upon the same line of shaft. This worm has a double thread and drives a worm wheel with 63 teeth (see Fig. 5).

At the end of the worm shaft is a small bevel capable of being slid in and out of mesh with a similar wheel operated by hand. The latter is for hand feeding. The worm-wheel shaft carries two plain gears with 25 teeth and 51 teeth, which mesh with two other wheels having 51 teeth and 25, respectively. Which pair of wheels shall be in gear is governed by a sliding plug with a key which fits inside the upper shaft, and is seen in Figs. 5 and 10. The object of this device is to furnish speed when the tool has finished its cut and the return traverse is put in operation. Its necessity is apparent when



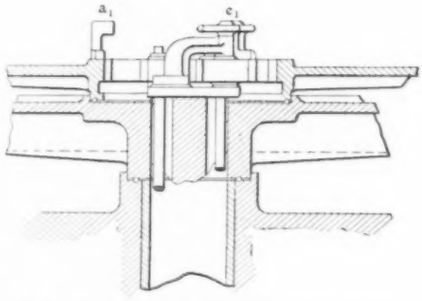


FIG. 13. ANOTHER FEEDING MECHANISM

it is remembered that it takes from 12 to 15 minutes to carry the tool the hight of the machine with the mechanism running at top speed. The shaft with the sliding plug carries at its far end a miter gear with 24 teeth meshing with another of the same size on a vertical shaft. At the

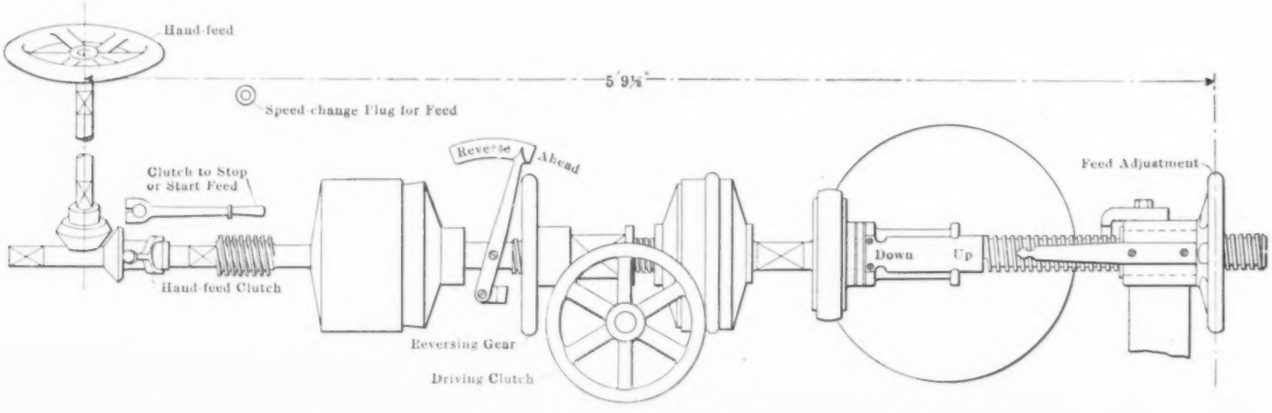


FIG. 10. THE FEEDING MECHANISM

lower end of the latter is a pinion with 26 teeth; the two latter are connected by a clutch operated by a lever and handle, shown in Figs. 5 and 10. This clutch disconnects the feeding mechanism from the tool. The large feed gear, which is located above the boring bar, rests on the large driving gear with a set of ½-inch balls between them. It has 264 teeth on its outer circumference meshing with the 26-tooth gear last referred to. It also has internal teeth to the number of 70 which mesh with an intermediate gear on the head of the boring bar. This in turn drives the feed-screw gears.

The 14-inch bar has two screws, two threads per inch right-hand. Their gears have 24 teeth. The 10-inch bar has one screw, two threads per inch, and an 18-toothed gear. The 6-inch bar has one screw, three threads per inch and an 18-tooth gear.

Referring to Fig. 1, it will be noticed that there are two flat, parallel bars bolted to the machine in a vertical position just behind the 12-inch scale held by the man. Fig. 12 explains these more fully. The clamp shown here carries a finger which can be set at any hight through a distance of about 6 feet and is for the purpose of operating a star wheel set on a head for facing purposes. Thus the operator can disconnect the upper friction wheel with its train of feed gears and come down on the floor and operate the whole machine from the starting point.

There is one more method of feeding besides those referred to. This is shown in Fig. 13. Three dogs *a*, *b* and *c* are mounted on the hub of the large feed gear. They engage the spokes of a star wheel *e*, which, in turn, rotates the feed screws in the bar by suitable gear connections. With the feed friction disk out of gear, the feeding is done by this arrangement with the large feed wheel stationary. By removing one or two of the dogs, regulation can be effected if the three together give too much feed. It is understood that the cost of building the machine was in the neighborhood of $10,000.

The bibliographical catalog of the books, pamphlets and periodicals of the celebrated Latimer-Clark collection presented by Dr. Schuyler Skaats Wheeler to the American Institute of Electrical Engineers, has just been completed and is about to go to press. This critical catalog has been in preparation for the past six years under the direction of W. D. Weaver with the collaboration of Brother Potamian, of Manhattan College, and a number of other authorities here and abroad. The expense of this unique work has been defrayed by Andrew Carnegie. As soon as the book comes from the press, it will be distributed to the members of the Institute, who, according to the deed of gift of the library are entitled to the catalog.

A Time-keeping and Cost Record System

By J. M. G. Fullman

Those who have investigated the subject of time keeping and cost-record making are aware that there are a number of systems on the market which work out beautifully in the prospectus; however, they are all more or less costly in initial installation and some of them bewilder the uninitiated with the multiplicity of detail. In attacking this problem, therefore, I had a two-fold purpose; not to spend any more money than was absolutely necessary to get the scheme working, and to so work the scheme that it would be simple and capable of being operated by anyone without much preliminary training and with a minimum of time.

DAILY TIME REPORT

Name H. Henrich

Date 10-25-06 Total Hours 10:30

STARTED	STOPPED	ORDER No.		TIME
		7	301 2:25	
		4552	206 2:40	1:50
				2:20
				6:50
		4588	206 1:50	
		4552	206 2:20	
		4074	201 1:15	

FIG. 1. WORKMAN'S TIME SHEET

The starting point in the system is the "Daily Time Report." See Fig. 1. In the column marked "started" are spaces provided for marking the time when any given job of work was begun. In the column marked "stopped" are similar spaces for the purpose of marking the time at which any given job was finished. The column marked "order number" contains spaces for marking the number or name of any given job or operation, for which the two previous columns will indicate the starting or stopping time, or, as might be otherwise stated, the basis for computing the time required for that operation or job. This space is large enough to accommodate other figures, such as the ledger classification numbers which will be referred to later on. The column marked "time" is for noting the elapsed time for the operation or job previously referred to. The card measures 3⅞ inches wide by 9½ inches high over all. This makes a convenient size for filing away in document filing cases. The ruling provides for five different jobs or operations during the course of a working day. These are amply sufficient for most cases, especially in manufacturing shops. The back of the card can be used, however, in emergencies, and thus avoid the necessity for more than one card per man per day. The cards are made of rather heavy paper, somewhat thinner than the paper commonly used for card-index files. It will be seen that the first and last time marks on the card indicate the time the man began work in the morning and when he stopped work in the evening.

The Time Stamp

The next point is to arrange for marking the starting and stopping times for each operation. This can be done with a pencil by observing the clock, but a better way is to use a time stamp. This, of course, cuts out the chance for personal error and is much more reliable in many ways. The sketch, Fig. 2, illustrates roughly the arrangement I have used. The time stamp proper is mounted on a pair of small angles, which, in turn, are fastened to a wooden base. This base has two notches marked *A* and *B*. The base is recessed under the angles to make room for the cards to pass freely. The base is fastened to a bracket, and the whole mounted on the wall at a convenient place. The notch *A* locates the card in the proper position by simply sliding it under the angles to that point. This avoids the necessity for any particular care in setting the card in order to prevent one impression from being over another and obscuring the record. It also helps to make the cards come through in an orderly way. The notch *B* is used when it is desired to stamp the card in the "stopped" column. The notch *A* is exaggerated to make the illustration clear. It is only necessary to have a very slight depression at this point. It is true, of course, that any one of a number of different time stamps can be used for this purpose by properly adapting the card to the stamp to be used. I have found the stamp we use to be very reliable with ordinary care. If proper care is exercised to arrange for setting the dials by means of a key, which the time clerk or fore-

man can have charge of, no difficulty will be encountered in the way of tampering with the clock to "fix" the record.

Totaling the Time Cards

The cards are collected each day. The next job is to compute the time for each operation or separate order, and to credit the employee with the total number of hours worked. This can be done mentally, or by figuring; but to facilitate the work and to save mental effort and time, I have

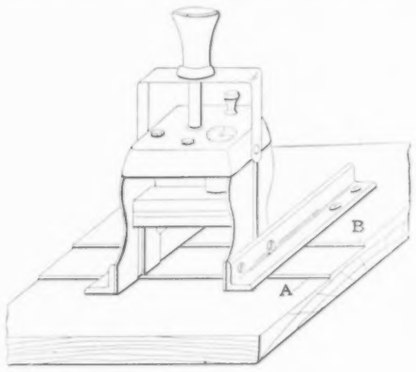


FIG. 2. THE CLOCK STAMP

devised a modified slide rule, Fig. 3. This rule is about 8 inches long by 1¼ inches wide overall. The stationary part is arranged to take in the starting time of 7 o'clock in the morning and extends to 8:30 o'clock in the evening. It, of course, can be arranged for any other limits. The slide is arranged to read from zero to 13 hours. Each division on both rule and slide represents 5 minutes. It will be noticed that the slide is merely a rule or scale and is used exactly as you would use a two-foot rule. The stationary part of the rule represents time, as does the slide, and the slide simply measures the elapsed time between any two given points. Another feature of the stationary part should be mentioned, and should be taken account of in arranging any similar system; the time allotted for lunch is omitted entirely. In this particular case a half hour is allowed for lunch; it will be noted that the rule reads up to 12 o'clock noon, and the next hour, 1 o'clock, is only 30 minutes away. Thus in measuring from 11:30 a.m. to 2:15 p.m., the slide is set with zero at 11:30, and opposite 2:15 is read the elapsed time on the slide. This little instrument can be made by any mechanic. The one I describe was made of wood with Bristol board strips for the figures and rulings. The paper strips were glued to the wood and given several coats of white lacquer.

The Pay Voucher Record

Figs. 4 and 5 represent the final stage in the system, the pay voucher record. This voucher is arranged for bi-monthly pay days. Fig. 4 takes care of all time from the first of the month to the fifteenth, inclusive. Fig. 5 takes care of the time from the sixteenth to the end of the month. Space is provided for noting the month and year, name of the employee, occupation, the rate per day, hour, etc. The forms, Figs. 4 and 5, can be used for all employees if desired, from the president of the company to the messenger boy. The classification numbers correspond with the ledger classifications for different departments and different general classes of goods. These classifications are noted on the time card as before referred to, according to the nature of each job or operation. The elapsed time is entered in the proper column opposite each day on which the employee worked. The total time for the day is also entered in the right-hand column. At the end of each pay-roll period or half-month, the various time vouchers are totaled and computed into dollars and cents under each column. This forms a check on the accuracy of the computations made both for total time and for total amount due. As each employee receives his pay he is required to sign the voucher, which, up to this time, is in the form of a separate slip 8½ inches wide by 7⅛ inches high. Each slip is handled separately. They are afterward fastened together and attached to the voucher check duplicate which was used in obtaining the currency from the bank. The single fold horizontally puts these vouchers in shape for filing in the regulation document files. These forms complete the record, and it has been my experience that it makes a very complete and compact arrangement, and one that can be used efficiently for quick reference in a case of any dispute as to amount due, etc. The blanks shown at Figs. 4 and 5 are printed on paper of two colors, one color for each half-month.

Operation of the System

In operation, the scheme is handled as follows: It is not necessary to have a time clerk as such, as it takes a very short time to attend to all the details. The clerk will insert the names of the employees and date in each card for the next day's work. These cards are placed in a box in the shop near the time stamp, and each workman, upon arriving in the morning, selects his card and stamps it in the first "started" space and inserts the order number of his particular job in its proper column. If his work is changed during the day, he will stamp the card in the "stopped" column, and immediately stamp it again in the next "started" section, marking down the order number of the new job. When leaving in the evening, he stamps his card again in the "stopped" column. The cards are collected the next morning by the clerk, and the elapsed time is figured out with the rule for each job and set down in the "time" column; the total of these entries in the column marked "time" being entered in the space marked "total hours." The clerk also notes the ledger classification for each job as the cards are figured, having the order file at hand for this purpose. The entries are transferred from the time cards to the voucher sheets, a new set of cards are made out for the next day, and the clerk is free to proceed with other work. The time consumed, of course, depends on the number of employees; for 50 employees it should take about two hours.

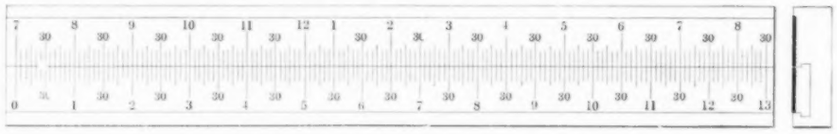


FIG. 3. SLIDE RULE FOR TOTALING TIMES

MONTH 190 NAME
OCCUPATION RATE PER
CLASSIFICATION
Date | 101 | 200 | 201 | 203 | 204 | 205 | 206 | 207 | 300 | 301 | 400 | Date | Time for Day
1 2 3 14 15
Time Total Amount | $

Received Payment _____

FIG. 4

PAY ROLL

MONTH 190 NAME
OCCUPATION RATE PER
CLASSIFICATION
Date | 101 | 200 | 201 | 203 | 204 | 205 | 206 | 207 | 300 | 301 | 400 | Date | Time for Day
16 17 18 29 30 31
Time Total Amount | $

Received Payment _____

FIG. 5

FORMS OF PAY-ROLL VOUCHERS

Isometric Plotting of Graphical Charts

The Relations between Three Variables Can Be Shown Easily. The Method Is Adapted to a Wide Range of Engineering Data

BY GUIDO H. MARX*

The adoption of graphical methods for the presentation of data or the solution of problems has grown to be of enormous significance to the various engineering professions. It is doubtful if any single factor has contributed more to clarity of conceptions and saving of time, than has the widespread use of ordinary rectangular coördinate paper. Every engineer and designer is continually availing himself of its aid in the plotting of experimental, or other, data and in the construction of charts for the rapid solution of problems. Each day brings some new adaptation, until it would seem that its valuable applications to engineering needs were literally endless. And yet, it is with the limitation of the usefulness of rectangular coördinate paper, and with a means of getting over this limitation that this article intends to deal.

The value of a graphical presentation of data lies in the instant and convincing understanding of the matter presented. The eye carries its message immediately and forcefully to the brain. The value of a particular chart is directly proportional to the clear and exact picture of conditions which it presents.

Limitations of Rectangular Plotting

Now, rectangular coördinate paper, whether laid off on either a plain or a logarithmic scale, can present directly such a picture concerning the relations of two variables only. A glance at Fig. 1 shows at once the wide range of usefulness of this paper and the limitation to which reference is made. There is an X-axis and a Y-axis, and on the plane of the paper we can locate points which represent all of the possible relations between two interdependent factors. As is well known, these relations commonly take the form of a straight or curved line—a typical one is shown in the chart. In mathematical terms such a chart expresses the relation between two terms one of which is a "function" of the other; that is, the values of the first term vary according as different values are assigned to the second term (or *vice versa*). The construction and use of such charts are too well known to require further explanation. What it is desired to emphasize is that such a chart can only show directly the relations of *two* interdependent terms, x and y.

But very frequently our problems involve *three* such terms and it is quite as desirable to represent their relations graphically. To give a single concrete illustration: We may wish to show the gallons of water discharged per minute by a centrifugal pump, throughout a range of varying peripheral speeds, *and* against a series of varying heads. If such a chart

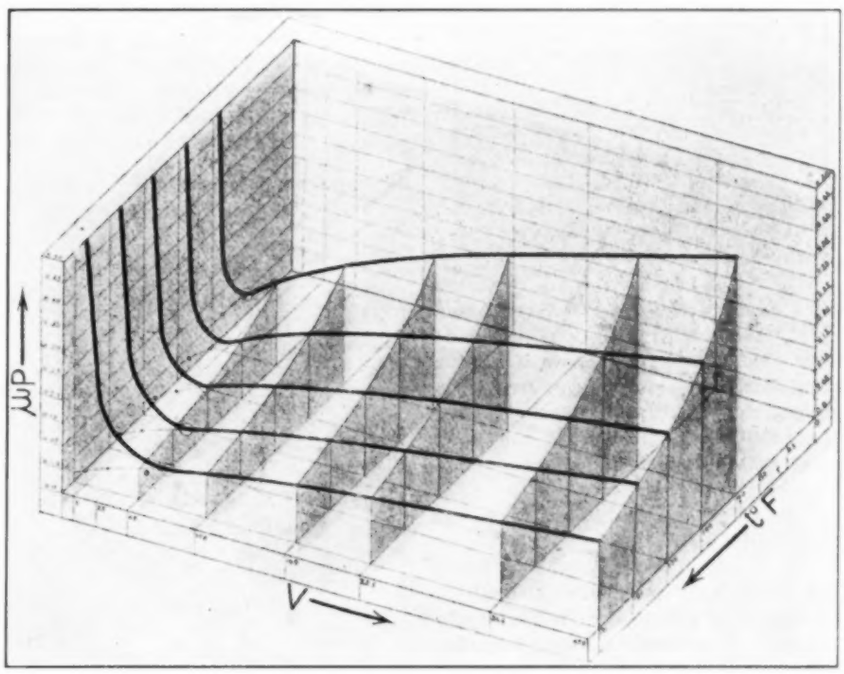


FIG. 3. AN EXAMPLE OF PLOTTING FROM THREE AXES

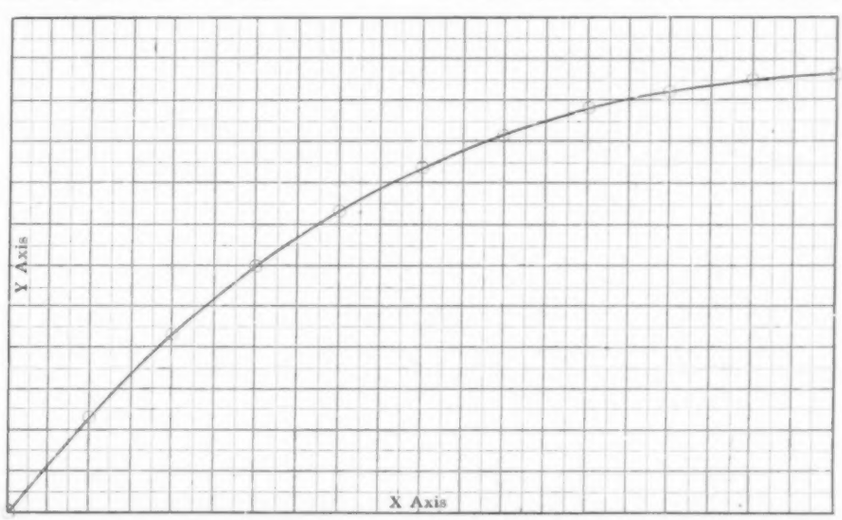


FIG. 1. A TYPICAL CURVE FROM RECTANGULAR PLOTTING

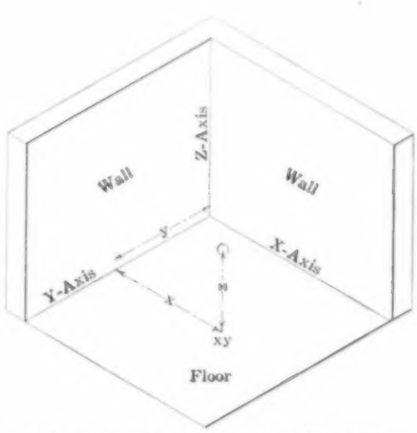


FIG. 2. A POINT PLOTTED BY ISOMETRIC ORDINATES

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were constructed it would show at a glance the proper combination of speed and head for maximum performance, and much else besides into which it is needless to enter here.

In all such cases we have three variable

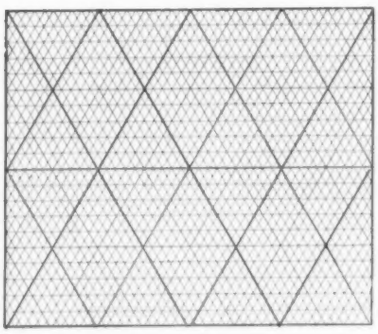


FIG. 4. A SPECIMEN OF ISOMETRIC PAPER

factors to deal with which we may term x, y and z; to represent them graphically requires the use of three corresponding axes which we may term X, Y and Z. To represent a set of three such axes on a plane surface we may avail ourselves of the well known system of isometric projection.

The Principle of Isometric Projection

It would be out of place to review the principles of isometric drawing here, but it may be recalled briefly that isometric projection is a form of perspective drawing in which there is no foreshortening but each dimension of length, breadth or hight is given its actual full value. The picture thus presented is much the same as if an object were set in the corner of a room and the eye of the observer was at an equal distance from the floor and each wall. The lines of intersection of the two walls, and of each wall and the floor would form the three axes. See Fig. 2. The angles between the pairs of axes become 120 degrees in this case. If, now, we wish to show the point whose three coördinates are x, y and z, we may measure off from the corner the distance y along the Y axis; from the point thus located measure the distance x in a direction parallel to the X axis, thus locating a point x, y; at x, y erect a perpendicular whose length is equal to z, and the extremity of the perpendicular will be the point whose position expresses the given relation of x, y and z. It is seen that if we take a series of different x y's and at each erect the corresponding z, the upper extremities of the z's will locate a surface whose form and position will give a very clear picture of the relationships of the three variables. Although not constructed on isometric lines, Fig. 3 (repeated from the AMERICAN MACHINIST, Vol. 31, Part 1, page 50) shows such a chart and serves to illustrate well the applicability of the method. This particular figure is from Professor Nicolson's valuable discussion of "Friction and Lubrication" and illustrates the frictional resistance of a rotating lubricated journal bearing; the three variables are surface speed, temperature and frictional resistance.

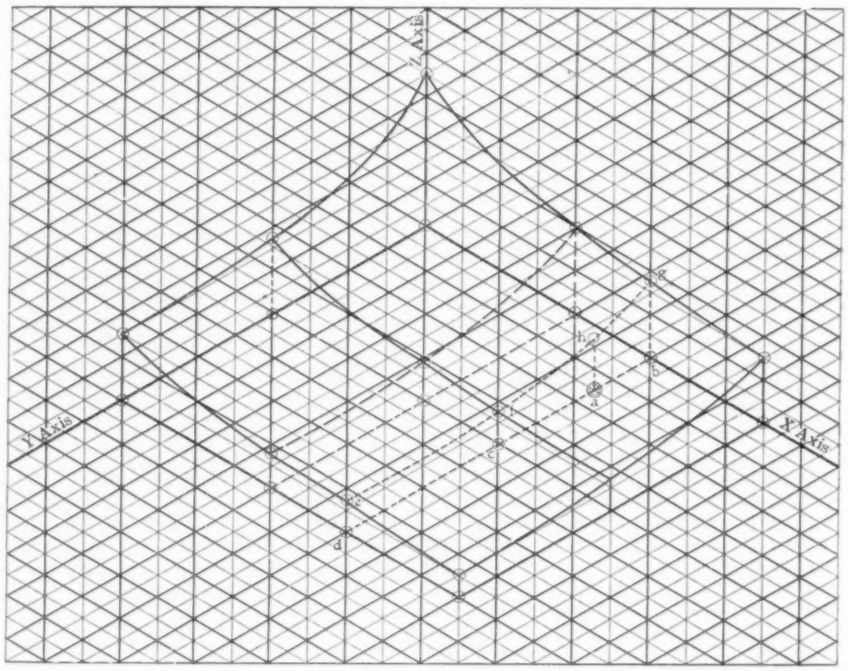


FIG. 6. AN ILLUSTRATION OF INTERPOLATION IN ISOMETRIC PLOTTING

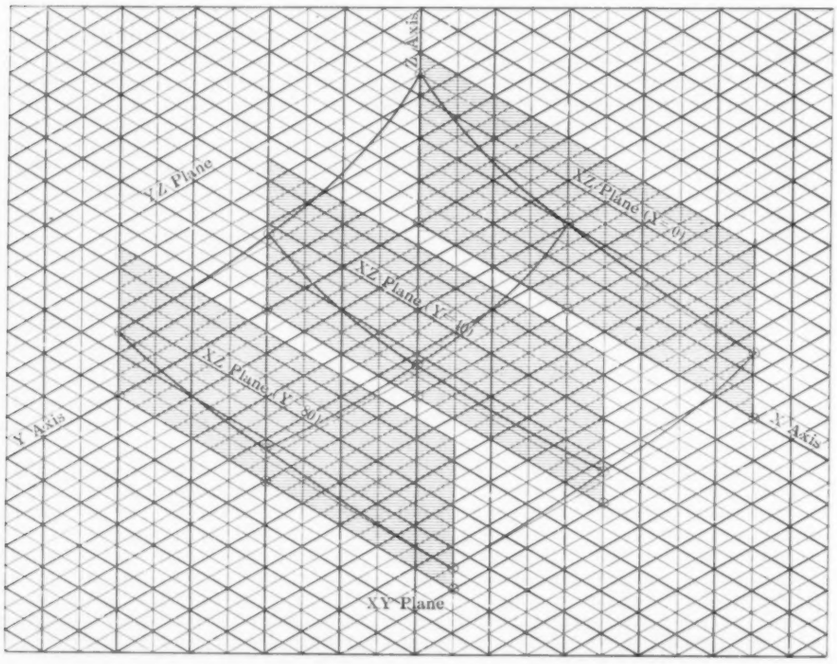


FIG. 5. A TYPICAL EXAMPLE OF ISOMETRIC PLOTTING

In order to facilitate the construction of such charts I have prepared for my own use a photographic plate from which I make "Van Dyke" prints of isometrically ruled coördinate paper, such as is shown in Fig. 4. The subdivisions measure 1/20-inch each way just as do those of ordinary coördinate paper.

A Typical Example of the Use of Isometric Coordinate Paper

The typical use of the paper is seen in Fig. 5, where points are located and curves drawn which show the surface determined by the following set of coördinates:

$y = 0$	$y = 40$
$x = 0$, $z = 35$	$x = 0$, $z = 17.5$
$x = 40$, $z = 20$	$x = 40$, $z = 7$
$x = 90$, $z = 15$	$x = 90$, $z = 7$

$y = 80$

$x = 0$, $z = 15$
$x = 40$, $z = 7$
$x = 90$, $z = 5$

It is to be borne in mind that x, y and z are used here in their algebraic sense, and may represent actual factors of velocity, resistance, pressure, temperature, horsepower, efficiency, or any other terms whose relations it is desired to express graphically and which are interrelated in groups of three.

The use of such isometric coördinate paper by no means ends when one has plotted isolated observed or computed relations. Fig. 6 shows one means for ready interpolation. The surface is similar to that shown in Fig. 5, and it is desired to find the value of z corresponding to $x = 60$, $y = 15$.

The point a is located for these values of x and y, and through a the line $b\,c\,d$ is drawn parallel to the Y-axis. Where this line cuts the base lines at b, c and d, respectively, erect perpendiculars $b\,g$, $c\,f$ and $d\,e$. Draw proper curve through g, f and e. At a erect a perpendicular until it cuts this curve at h. The ordinate $a\,h$ is the required value of z; in this case $z = 17$. The foregoing example illustrates also the method of use of the paper for charts for the graphical solution of problems involving three quantities.

Contour Lines

Another valuable characteristic of the paper is the ease with which "contour" lines may be shown, by passing planes parallel to any one of the three coördinate planes. Thus, in Fig. 7, if the plane $a\,b\,c\,d$ is passed parallel to the original $X\,Y$-plane, at a hight of 15 divisions above it, the curve $a\,e\,f\,c$ will be established ($p\,a$, $g\,e$, $h\,f$ and $q\,c$, each being

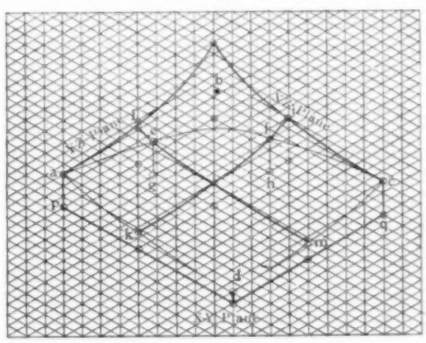


FIG. 7. ISOMETRIC PLOTTING OF CONTOUR LINES

equal to 15), which will give all the possible relations of x and y corresponding to a value of 15 for z. Similarly, the curve $j\,f\,k$ gives all the possible relations of y and z for $x = 40$; and the curve $l\,e\,m$ gives all relations of x and z for $y = 40$. This, to give but a single illustration, is of extreme value in showing at a glance all of the possible combinations of two variables for a given value of the third factor; as, for instance, the series of peripheral speeds and corresponding discharge heads corresponding to a given efficiency of a centrifugal pump.

The values of the variables corresponding to maximum or minimum conditions are equally evident from a glance at an isometric diagram.

Eight Corners are Formed by the Intersection of the Isometric Planes

It may be borne in mind that at the intersection of the three coördinate planes eight corners or angles are formed and that in constructing a diagram one is not limited to the ordinary set of isometric axes (as used in Figs. 2-7), but has a choice of eight sets, as shown in Fig. 8.

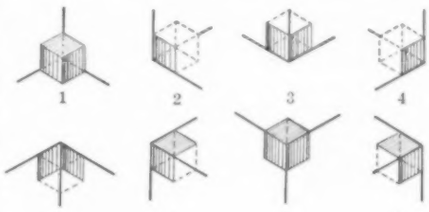


FIG. 8. THE EIGHT SETS OF ISOMETRIC AXES

Here, to make matters clear, a cube has been placed in the "corner" in each case, with those faces shaded which lie in or in front of coördinate planes. While the set of axis No. 1 will be found to answer ordinarily, one of the others occasionally may be found to suit some particular data with less confusion of lines.

Just as, with ordinary rectangular coordinate paper, familiarity has led to an increasingly wide field of usefulness, so it will be found with this. Where three interdependent quantities are to be dealt with the isometric paper is quite as valuable as is the rectangular paper for expressing the relations between two variable terms.

More than 17,000,000 pounds of metallic aluminum were consumed in the United States during last year, according to W. C. Phalen, of the United States Geological Survey. This is an increase of 2,301,000 pounds over the consumption in 1906, which amounted to 14,910,000 pounds. The great increase in domestic use predicted in the early part of 1907 was not realized, and the failure of the predictions is attributed by Mr. Phalen, in large part at least, to the falling off in demand toward the close of the year as a result of general business depression.

Wireless telephony keeps forging ahead simultaneously with wireless telegraphy. The latest incident illustrative of this fact is the achievement of three French naval officers, who have perfected apparatus for wireless telephony, with which, since May last, they have been conducting secret trials according to the *Engineer and Iron Trades Advertiser*. Experiments have been carried out between Paris and Dierre, a distance of 100 miles, and it is claimed that singing and talking can be heard distinctly over that distance. This seems like a step forward.

The Relative Positions of Manual Training, Trade Training and Technical Education

By Instructor

The only education in book form which survived the Dark Ages was held by the monks. As years went by they disseminated what learning they had to their own successors, and in homeopathic doses to the lay population. They apparently realized that in this book learning lay a power worth preserving. Of it they made a fetich which we still worship, in a way. Other learning, the knowledge of crafts and practical knowledge, was passed by word of mouth, precept and example from father to son and from master to apprentice; never gathering momentum because there was no literature to preserve and collate its mysteries.

In those old times began the mutual contempt, verging on war, between the practical, represented by the guilds, and the theoretical, represented by the monks. The latter dominated, through the power of logic from the accumulated philosophy of centuries, over the limited, self-centered and self-sufficient secrecy of the trades. The advantage then gained made itself long felt and is still dominating our school systems. It gave us the dead languages, mathematics and philosophy, but it barred from the schools and from the world their practical use.

Rise of the Technical Schools

This was the state of book learning at the time when technical schools were first established. The founders of these schools were in many cases hard-headed, hard-fisted men of affairs with large faith in the schools they proposed, and small idea of how to accomplish their purpose. These men expected their schools to turn out men skilled in a trade; men who should become leaders of men. Since they were to be schools, what more natural than that they should engage men from other schools, that is colleges, to lead them? And what more natural yet than that these same men should make these technical schools what they are, colleges with technical leanings? The original purpose to have men skilled in the arts to teach trades, and other men, subordinate to them, skilled in mathematics and logic to teach the humanities, was utterly lost sight of, for the simple reason that the accumulated logic of centuries enabled the professional educator to overweigh the shop man with his skill plus and logic minus.

The technical-school product then necessarily failed as practical workmen, but soon evolved into competent designers, engineers and leaders. This was quickly seen and they immediately disdained the very product which they were originally engaged to make. They began to change

their schools into engineering schools, which change is at the present day nearly complete.

The graduates of the technical schools aroused the jealousy of the journeymen educated in the shops, whenever they attempted to be workmen. They had the same feeling that dominated the guilds of England; that there was and should be no royal road to learning. As a matter of fact there was then no trade literature worthy of the name. All the knowledge that a workman had came to him purely as a matter of memory, usually the memory of one man. The rest he had to invent himself. The process was conducive to originality, but not likely to make any one man's store of knowledge great outside one little, narrow line. When the journeyman from the shop met the graduate of the school comparisons were made which were particularly odious, because there was no fair basis. The shop-trained man had manual dexterity, and if he added native ingenuity and mechanical interest he succeeded. The school man had mechanical theory and a trained method of reasoning, and if he added a native ability to understand shop processes he was equally successful. As a shop workman he was, necessarily, an immediate failure. Those who acquired the necessary dexterity did so only at an expense of time entirely out of proportion to the results gained.

Manual Training Schools

The first attempt to provide skilled workmen having failed, manual training was hailed as the succor needed. Manual training has done all that its real projectors expected, but nothing at all of what its later advocates claimed. Manual training teachers were taken from the technical schools, without other experience. They were expected to change young children in a few hours from immature, careless butterflies into skilled, careful craftsmen. What they expected themselves was that they would rouse an interest in crafts and add to the belief in the dignity of labor, in which I feel that they have been as successful as could be expected. They were not decided enough in their stand to obtain suitable housing and equipment for their work. They have suffered the penalty of their lack of foresight. The result is that manual training is incomplete, it falls far short of teaching a trade from which its graduates may expect to earn a living. It fails because it does not start in a business-like way; it uses toy equipment and manufactures toys. It fails because it does not use commercial methods; it treats its work as "problems," not "jobs," and their solution of each problem is the one that will most surely make for manual dexterity and in consequence it avoids the easy way, which is usually the "commercial" way. It fails because it does not go far enough. It allows a pupil to advance to the next stage on completion of a single semi-satisfactory job, instead of insisting that good work shall become a habit. It is apt also to be careful to inculcate in a boy's mind the idea that he does not want to learn a trade; the idea of the teaching gentry is that all with whom they come in contact should aspire to the more "gentlemanly" (?) pursuits.

Trade Schools

Now the trade-school movement is having its boom. All over the country there is a quiet movement in favor of trades for the younger generation. The people of 25 to 45 years of age, who are the moving power in everything, are the very ones who were misled in their youth into the idea that soiled hands were not creditable. Now they begin to prefer a soiled hand to a soiled soul. They begin to see that they have suffered financially as compared with their friends in the trades. They are beginning the other vibration of the pendulum that swings toward a recognition of the usefulness and dignity of the man who makes things; they begin to realize that not everyone can be an engineer. From this class of people comes a demand that there shall be an opportunity for their sons to learn to work with their hands, and a hope that, if they do learn to be dextrous it will be a stepping stone to greater things. They feel that many of the great names of engineering history have been those of men whose boyhood was spent in humble circumstances, and who earned their way up through the shop; they feel that the chance that was open to these men is denied their sons by the modern shop system. To meet this demand is a seemingly simple proposition. It was just as simple when technical schools were first proposed, but the remedy went astray. That is just the thing that must be guarded against if real success is to attend the movement. I say "real" success advisedly, for a certain measure of success is bound to come of any educational movement of this kind, since there is nothing to compare with, nothing to set a standard of success. In business the measure of success is its profits. In a school the profits are measured by the business success of the graduates as measured by the average of the uneducated. Since a school at its worst makes a selection of the material offered it and graduates only a small number of picked men, it can obtain credit as a successful institution even if it does not do a really useful thing.

Scholastic Element Must Not Rule

The technical schools failed in their first endeavor because they were allowed to be ruled by the scholastic element. If the trade school is to succeed it must be entirely in practical hands. It must teach some of the humanities, true, but it must not let the tail wag the dog. A trade is something that no man, no matter how well educated, can comprehend except by actual, long-continued contact. No matter how anxious for success the college man may be, if he does not know the trade he is teaching from a commercial point of view he cannot possibly teach it so that the product of his school can fit into commercial shops.

Other than this one there appears to be no inherent difficulty with a trade school. The aims of all these types of schools have been the same at one time or another. Two attempts have departed from the course. Will the third fare any better?

To sum up the present relation of these three forms of training it is safe to say that manual training serves to awaken a constructive spirit in children which leads them to enter technical schools if they can make good mentally, and if their parents can afford it. For the rest, who are mechanically inclined, it leaves them stranded usually because even the few who would be acceptable in the shops where they might learn a trade have been educated to consider themselves above accepting the commercial conditions which they find there. Trade schools today are mostly in private hands. They are only injuring the cause, because for the greater part they are run to cater to a demand for the greatest apparent results for the least cost. The outcome is that they offer short courses in the direct practice of the trade offered, with none of the side training in contiguous studies or the thoroughness which makes for skill.

Technical schools take boys of all classes and train them to fill positions involving designing and engineering, without the necessity of skilled manipulation. While they are undoubtedly susceptible of improvement, they are so far in advance of the other schools in organization and definite aim that more attention should be given to the others.

Relation Between the Three Schools

What should be the relation between these three branches? My views are the results of years of study of the subject from the points of view of student, workman, engineer, employer and teacher. I believe that manual training should begin with the very kindergarten and should continue to the fifteenth year for the average boy. No attempt should be made to introduce any work which would have a commercial value. No work requiring elaborate equipment should be undertaken. Purely hand work related to as many different trades as possible should be given. Visits to trade schools, technical schools and industrial establishments should be a regular part of the course for the last two years. Endeavor should be made to educate the boys to the importance and dignity of work and to educate them away from snobbery. They should be brought to realize that workmen whose English is not beyond reproach and whose idea of full dress is limited to a paper collar may be just as good company for them as anyone else.

From these schools, where the manual training should be made very subordinate to the three R's, the children should go to a trade school whose commercial conditions should be approximated, and intelligent, organized effort be made to reduce the trades to as scientific a basis as possible. Endeavor should be made to give something of the principles of good citizenship, and a study of the business side of manufacture should be made to the end that the pupils should become useful citizens and broad minded in their attitude toward employers, when they are employees, and toward labor, when they are employers.

The courses should be so arranged that any boy who might attend for only one or two years could go out with a definitely increased earning capacity, so that the inability of his parents to carry him through should not be more of a hindrance to him than is necessary; at the same time no diploma should be given unless a full course was carried out with credit in all its parts, to the end that the school's diploma should have a value, recognizable both by student and employer.

To the graduates of the trade school the technical school should offer credit for the shop training, and whatever studies they might offer that were in the technical curriculum, and then also offer the students an opportunity to work for wages, journeyman wages too, in commercial shops part of the time and study in school the other part.

A succession of schools of this class would bring about one object greatly to be desired; that is, that a student could go as far as his mentality would carry him, or as far as he could afford to go, without feeling that he had wasted all his effort by not going farther.

An authority on the subject states that a hot bearing may be caused by using an unsuitable alloy containing a large proportion of zinc.

The Oldest Machinist Still in Active Service

In these days which we have come to think of as being so strenuous that a man is old at 60 and fit only for a pension or chloroform at 70, it is refreshing to come across a man who is not only alive at

ISAAC OSGOOD

90 and over, but instead of sitting around waiting for the long journey into the great unknown is still on the job. Such a man is Isaac Osgood. Arriving at Amesbury, Mass., a little after 5 p.m., on a hot day early in July, I naturally expected to find Mr. Osgood resting or at least getting ready for supper. But instead he was still at work in his little shop, busily drilling a lot of carriage-shaft couplings, which is one of his many patents, using his drilling jig with all the dexterity of an expert drill hand. These are made by the barrel, the drop forgings coming mostly from his old friend "Charlie" Billings, of Billings & Spencer Company, Hartford, Conn.

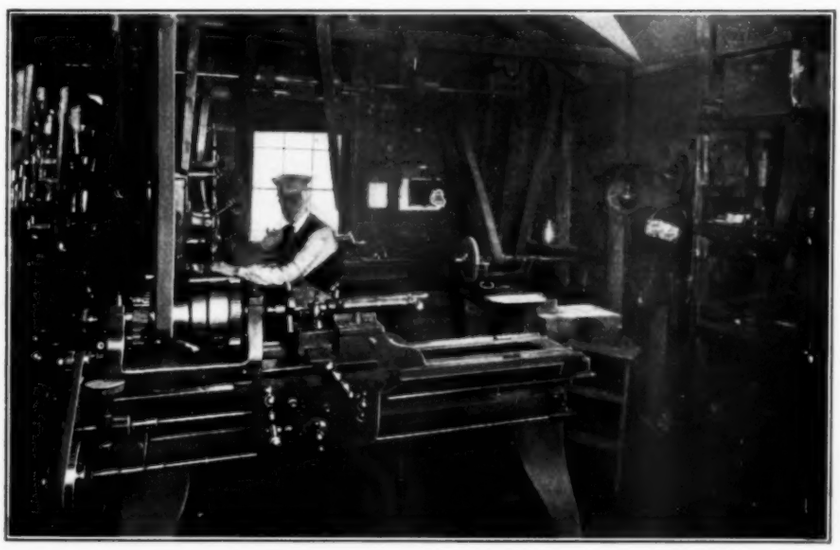
One can hardly realize that Mr. Osgood will be 94 years old next December, but such is the case unless the arithmetic and the almanac have both gone astray, as he was born in 1814 and was apprenticed to Bailey Sargeant in West Amesbury on June 10, 1831, at the age of 16½ years. Here he served four years at a wage of $30 a year, which included board and clothes, but even this did not leave enough surplus for a large amount of luxury or finery. Mr. Sargeant was a good employer, however, and gave him every opportunity to learn all to be had at that time, advancing him to $13 a month the last year of his apprenticeship, which lasted 4 years. While learning his trade he had several opportunities to use an old post planer in a Newburyport shop, which was one of the first tools of its kind in this country, being contemporaneous with the old tools in the shops of Silver & Gay at North Chelmsford, Mass.

After this his field of labor varied from steam-engine building during the hard times of 1846 to school furniture, folding beds, refrigerators and shaft couplings. Amesbury is full of carriage business and his first patent was granted in 1865 on a carriage axle. Not many years after this he went to the Remington Arms Company at Ilion, N. Y., and when he left there in 1880 he had been their master mechanic for a number of years. He still has a number of models of guns made during that time and has some very interesting note books which give the cost of typewriter building in the early days of the industry.

His machine-tool activities are best known by his machine for grooving oil-ways in bearings, one of which is shown herewith. These are being used very successfully in a number of the larger shops and Mr. Osgood is still pushing their sale as vigorously as many a man 40 years younger than he. The oil grooves in these boxes do not run out or stop at any point, but the oil has a continuous path at all times. Used in carriage wheels these have run a year with one oiling and Mr. Osgood believes that the results obtained in machine tools are much better than with the ordinary oil groove which is not continuous.

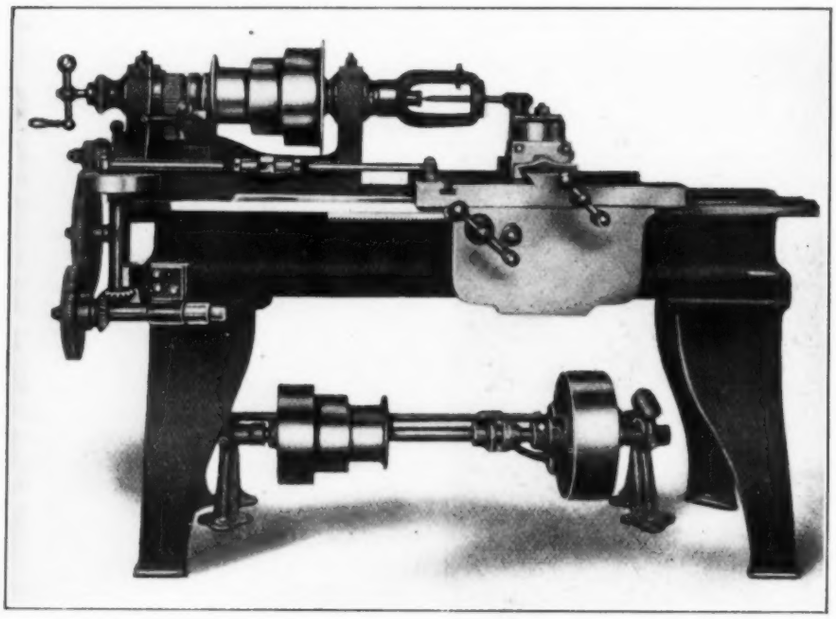
Among his other patents is one for grooving gas-engine pistons between the piston rings to assist in the lubrication, and a self-draining faucet to prevent the water system of a house from freezing when left in cold weather.

The interesting part of the interview was that Mr. Osgood is in full possession of all his faculties, has kept up to date



MR. OSGOOD AND HIS SHOP

in mechanical lines, as is evidenced by his use of the electric motor to drive his shop, and it is difficult to realize that one is talking with a man who has seen practically the whole development of the machine-shop industry in this country. And it was very refreshing to meet a man who was such a shining example of a ripe old age that must be the result of a sane observance of the laws of right living, calmness and moderation, both physically and mentally.



LATHE FOR CUTTING SPIRAL GROOVES IN BOXES

Forced Lubrication for Axle-boxes*

By T. H. Riches and Bertie Reynolds

This paper describes a system of forced lubrication as arranged for the driving axle-boxes of some of the steam cars of the Taff Vale Railway Company. Before entering into a detailed description of the system used, it will perhaps be advisable to give a few of the more necessary particulars concerning these cars.

*Paper presented to the Institution of Mechanical Engineers, England.

The engine is carried on a four-wheeled truck of 9 feet 6 inches wheel base and 2 feet 10 inches diameter wheels, the boiler (of double-ended locomotive type, lying transversely across the frame) being placed immediately over the center of the leading or driving-axle. The front end of the coach is supported by means of a bogie center, carried between the frames at a distance of 4 feet from the trailing-axle, or 5 feet 6 inches from the leading-axle. When the car is loaded with its full complement of passengers, the weight on the driving-axle is 15 tons 13 hundredweight, the weight at the rail being 17 tons 6 hundredweight. The journals are 6 inches diameter by 9½ inches length; therefore, the pressure, taking two-thirds of the projected area of the brass as bearing area, is 466 pounds per square inch, the number of the revolutions of the journal, at a speed of 30 miles per hour, being practically 300. With this pressure and high rubbing velocity an undue amount of oil was being used with the ordinary method of lubrication, while cases of the bearings running hot were not infrequent, therefore, the following arrangement for lubricating the journals under pressure was adopted.

To a cross-stay in front of the driving-axle, Fig. 1, a small gun-metal tank of rectangular section, Fig. 2 is fixed. On the side of this tank, nearer the driving-axle and in connection with the tank, two small rotary pumps—right- and left-handed—are fitted, the one for forward

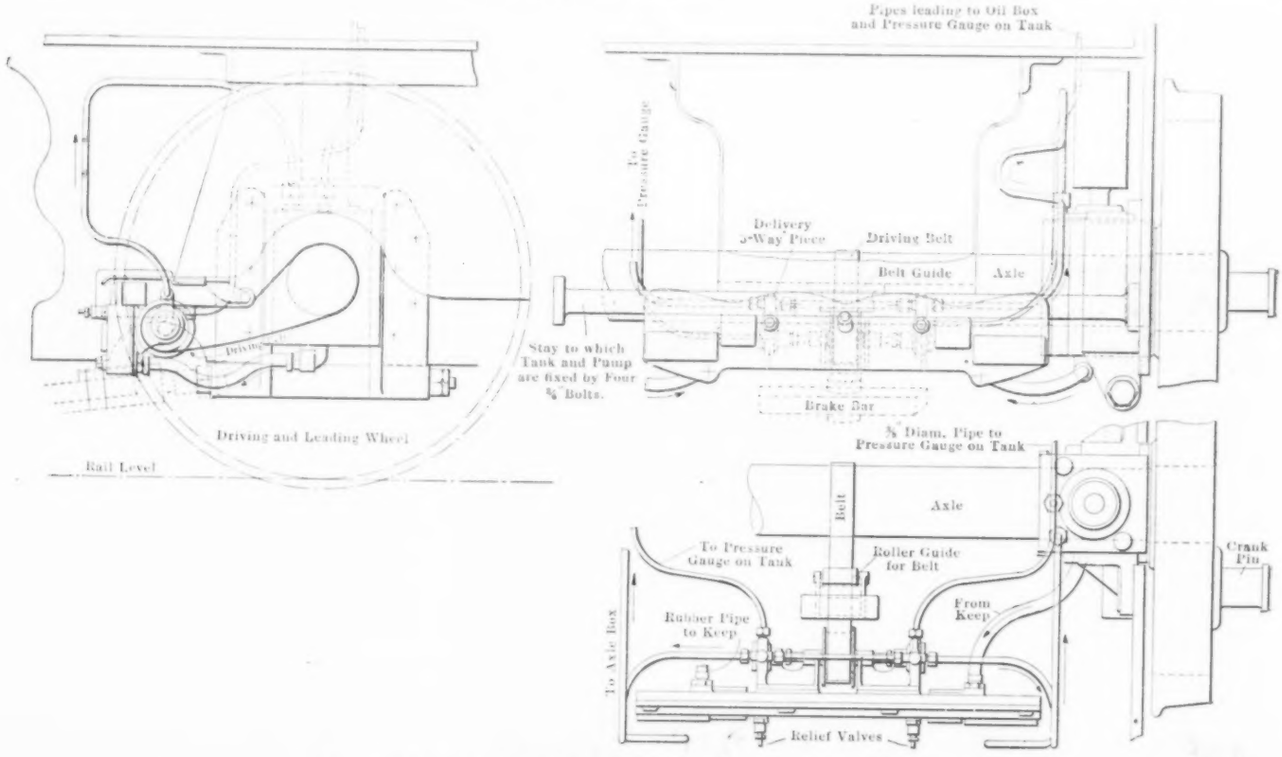


FIG. 1. A SYSTEM OF FORCED LUBRICATION FOR AN ENGLISH FREIGHT CAR

running and the other for backward running. These pumps are driven directly from the driving-axle by means of a belt passing over a flanged pulley carried midway between the pumps, the pulley containing on each side of it a roller-clutch, somewhat similar to a free-wheel arrangement, fixed to the driving-spindle of the pumps. By these means, the one belt drives either pump forward or backward, the other pump being free.

Following the process through, for the lubrication of one of the journals, when the car is in motion, oil is pumped from the tank and forced through a coiled copper pipe to the top of the axle-box, Fig. 3. An oil channel, 8¼ inches long, 9/16 inch deep, is cut in the crown of the box, leaving a margin of metal at each side of the channel of ⅜-inch flat, which is found, when the box is properly bedded to the journal, to be quite sufficient to insure that it shall be perfectly oil-tight at the pressures attained.

After passing round the journal, the return oil is collected in the axle-box keep, and from there is brought back to the tank by means of a flexible pipe which allows for the rise and fall of the axle-box, care being taken that the reservoir into which the oil is returned is sufficiently below the keep to drain it. At each side of the axle-box keep a half-ring is fitted with bearing area about ⅜ inch wide. These half-rings are bedded well to the axles, and are supported upon a couple of small coil springs which hold the rings up to the journal with a fair pressure, and so prevent the escape of oil along the journal on the bottom side. The supply tank is so arranged that the return oil, after draining from the keep

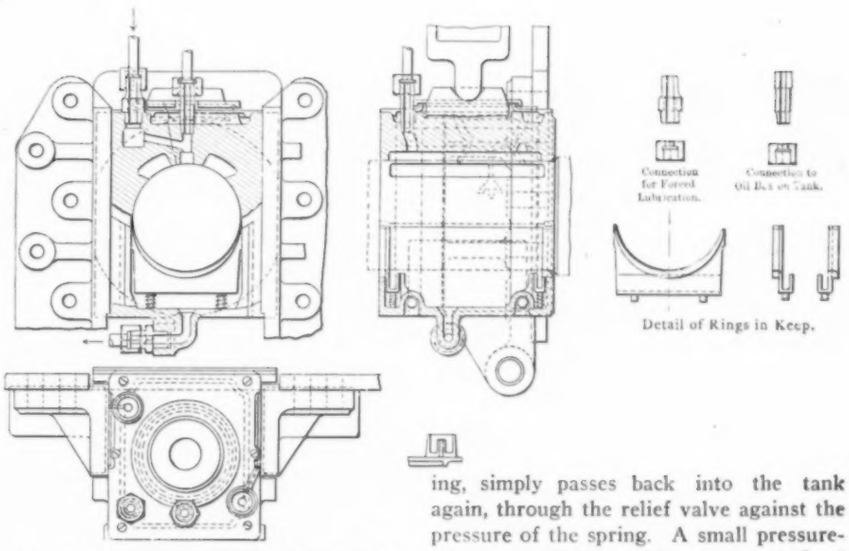


FIG. 3. DRIVING AXLE BOX AND KEEPS

into it, shall pass through a filter before being again sent through the pump. Such briefly is a general description of the method adopted.

Many points arise, however, in regard to the working of the arrangement which it will be well to explain. In the first place, the pumps when running fast (at a speed of 30 miles per hour, the revolutions of the pump are 440 per minute) deal with a greater quantity of oil than can be accommodated in the circuit at a pressure of, say, 20 pounds per square inch, above which, in practice, it has not been found advisable to work. A relief valve is, therefore, fitted at each pump with an adjustable spring which enables the pressure at which each pump shall work to be regulated. The excess oil, when pumping, simply passes back into the tank again, through the relief valve against the pressure of the spring. A small pressure-gage connected to each pump, and fixed in the driver's cab, shows the pressure of the oil pumped on both forward and backward running, while also acting as an indicator should failure of either pump occur at any time. Should this happen from any cause, the ordinary system of lubrication, by means of a lubricating-box in the cab, is at hand. This lubricating-box is also necessary to enable oil to be put into the axle-boxes after the car has been standing for a day or two, and so avoid starting away with dry axle-boxes.

To prevent the oil from the running pump flowing into the other pump and causing it to run backward, a small ball-valve is placed in the three-way piece leading from each pump to the circuit. The movement of the axle-boxes relatively to the tank and pumps was met in the first instance by trying different sorts

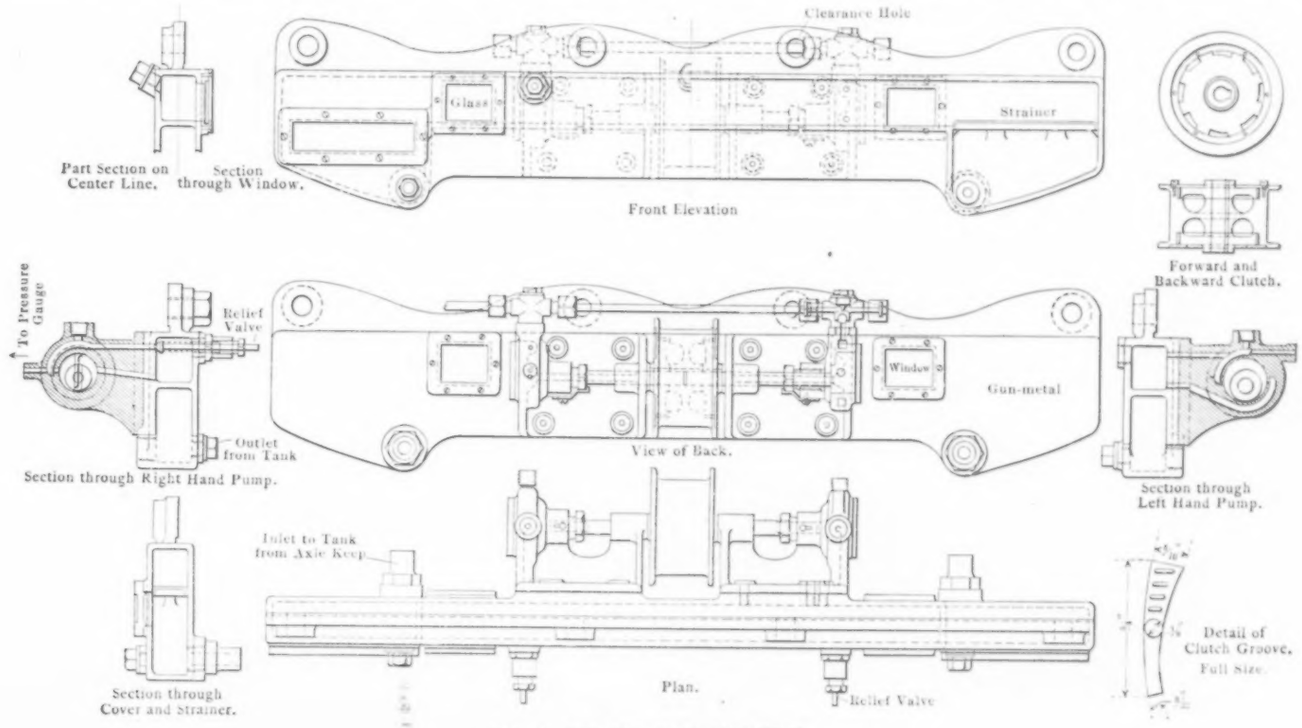


FIG. 2. THE OIL TANK AND PUMP

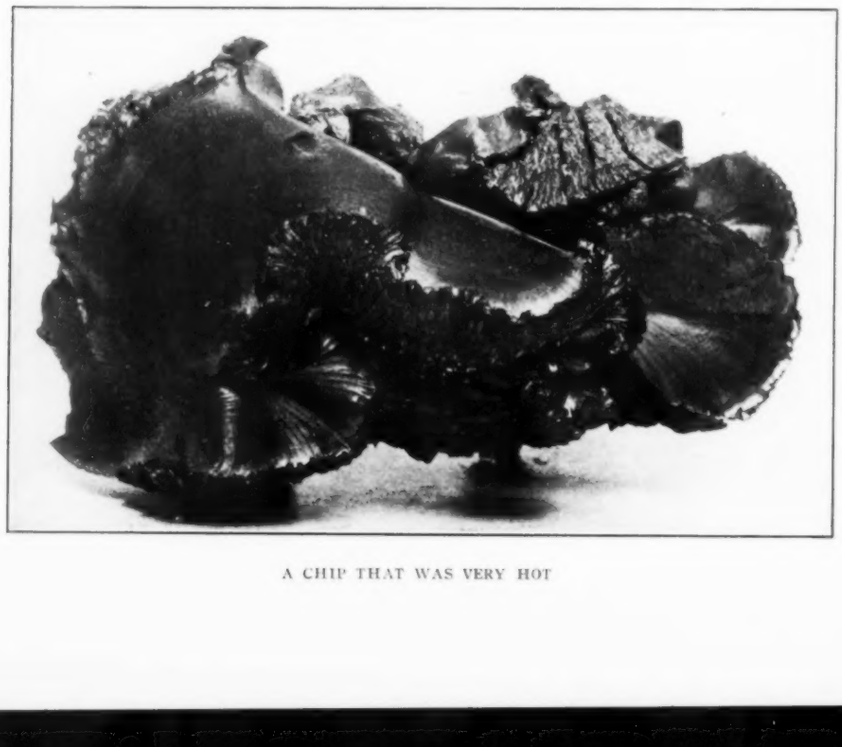
of flexible piping, but finally, ordinary coiled copper piping was adopted, both on account of its comparative durability and of its accessibility at any time.

The belt drive for the pumps at once gives a simple method of driving and one which allows for a small relative motion of the axle and pulley. It is apt, however, to soon become saturated with oil and then slipping occurs. An occasional application of one of the various belting mixtures, however, greatly reduces this slipping. When equal relief-valve springs were put in, it was noticed that the pressure indicated for forward and backward running varied considerably, probably due to the difference in the slip of the belt in each case. The filters in the tank are removable, and are taken out and cleaned at the end of each day's work, the oil being first drawn off through the stop-plug, the thicker part of the oil, after straining, being then replaced by a small supply of fresh oil.

The foregoing description shows one method of dealing with an everyday problem in connection with the running of railway motor-cars, or any rolling stock in which the pressure on the bearings, combined with the rubbing velocity, is excessive. The matter is one of importance to all concerned in the design and care of such stock.

An Interesting Chip

The chip shown in the accompanying illustration was cut from a locomotive driving tire at the Readville shops of the New York, New Haven & Hartford railroad in a Putnam driving-wheel lathe. It is a very heavy chip, but is even more remarkable for the unmistakable evidence of extreme heat, as it will be seen that curves in the tool marks and the general contour of the chip indicate a slight flow of metal. There are also signs of incipient welding or fusing at points that leave little doubt on the subject. It speaks well for the capacity of the lathe, the tool and the shop.



A CHIP THAT WAS VERY HOT

A Testing Machine for Automobile Transmission Members

By Frank C. Perkins

The accompanying illustrations show the apparatus and methods used for testing transmission members at the plant of the Rambler Automobile Company, at Kenosha, Wisconsin. The test that is shown is to determine the twisting pressure the driving shaft will withstand.

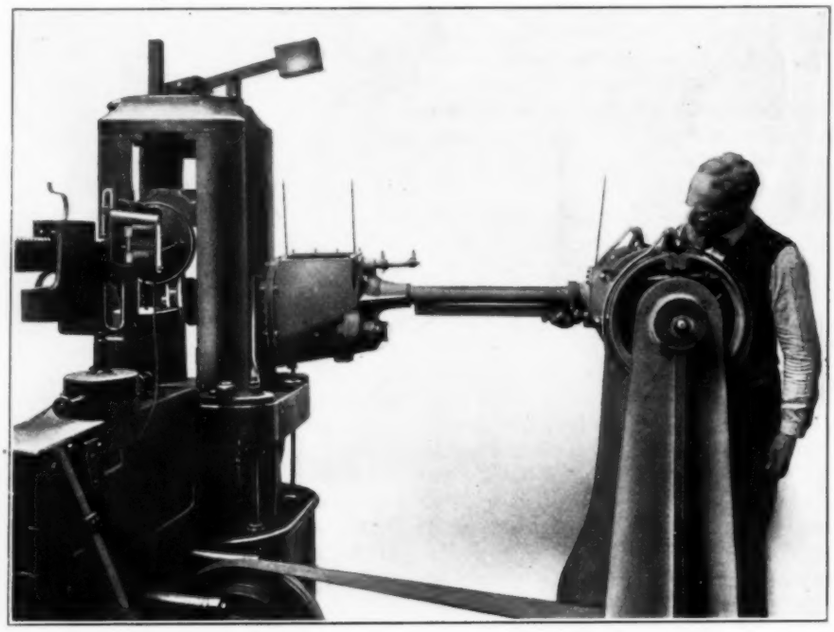


FIG. 1. A TESTING MACHINE SET UP FOR AN AUTOMOBILE TRANSMISSION

FIG. 2. A TWISTED AUTOMOBILE SHAFT

The shaft was rigidly held at one end and twisted with a rack and pinion at the other on a pitch radius of 2¼ inches, which corresponds to the length of the crank. It was found that the pressure required to twist the shaft was 12,000 pounds. On increasing this pressure to 13,000 pounds permanent set took place. Similarly a pressure of 14,000 pounds was required to twist the squared portion of the shaft, and permanent set did not take place in this section until the application of a pressure of 15,000 pounds.

Fig. 2 shows a shaft that has been twisted about one-half of a revolution without a sign of rupture. As the maximum twisting effort of the engine is only 2800 pounds, there is an ample factor of safety in this type of shaft.

Referring to Fig. 1, the three vertical rods ending in fine points and extending upward from the gear case at one end and the rear axle housing at the other, are used as sights to denote the amount of deflection of the transmission member. As originally set, all three are, of course, in line. The ends of the rear axle are held firmly in brackets supported from the floor, and the twisting stress was applied to the forward end at the point where the power is applied from the engine. A continued pressure of 12,000 pounds at a point 2½ inches from the center of the shaft, which is the length of the crank, produced a twist and permanent set in the rear axle, but no effect was noticed in the torsion tube; 24,000 pounds was required to distort this tube.

Comparisons of Carbon and High-speed Drills

Averages Show that the High-speed Drills Drilled 57 Times as Many Holes as the Carbon Drills, Tests Were under Exactly Same Conditions

EDITORIAL CORRESPONDENCE

A series of tests was carried out at the suggestion of one of the editors of the AMERICAN MACHINIST to furnish data to answer the questions: What is the average drilling capacity of a given high-speed steel twist drill compared with a similar carbon-steel twist drill used under the same conditions? and what is the relationship between the hardness of a twist drill, as measured by the scleroscope, and its drilling capacity? These tests were made possible by the courtesy of Messrs. Lincoln and Williams, of the Lincoln-Williams Twist Drill Company, of Taunton, Mass., and Mr. Shore, of the Shore Instrument Company, of New York City. All of the tests aside from a few to determine the hardness of the material drilled were carried on at Taunton. All of the drills, all of the material that was drilled and the accompanying necessary machine-shop equipment were furnished by the Lincoln-Williams company. The scleroscope was furnished by Mr. Shore, who also assisted in some of the hardness determinations.

GENERAL CONDITIONS

At the outset it was determined to test nothing but stock drills, selected in groups at random from the regular factory-finished stock. The size of 11/16-inch was settled upon as a convenient one to use; all of the drills tested were taper-shanked. The drills finally selected for testing were used in the condition in which they were taken from the stock room; thus the grinding was the same as the grinding of the drills when sent out to the trade.

Number of the Series.	Number of Drills in Series.	Maximum Hardness Variation in Scleroscope Degrees.
1	9	9
2	11	9
3	8	4
4	8	6
5	4	8
6	3	3

TABLE I. MAXIMUM VARIATION IN HARDNESS FOR VARIOUS GROUPS OF HIGH-SPEED-STEEL TWIST DRILLS.

The material used for the drilling tests, aside from a few that were considered as preliminary, was annealed tool steel in flat bars of an uniform thickness of ¾ inch. The drills were started by hand through the scale on these bars and were located by means of center-punch marks. The holes were drilled as closely as convenient in order to get the maximum number into each bar. However, care was taken that the holes should not break through. Oil was applied by an ordinary squirt can in sufficient quantities to provide ample lubrication.

Both speed and feed were kept uniform for each kind of drill. For the carbon-steel drills, the speed was 190 revolutions per minute and the feed 0.006 inch per revolution. For the high-speed steel drills the speed was 312 revolutions per minute and the feed 0.006 inch per revolution. It will be noticed that the speed of the carbon-steel drills is somewhat higher than that which is ordinarily recommended for a drill 11/16 inch in diameter; the speed of the high-speed-steel drills is some 60 per cent. greater than that of the carbon-steel drills.

Drill Number.	Hardness on the Scleroscope Scale.
1	88
2	83
3	86
4	81
7	87
14	84
18	83
31	89
36	85
43	84
38	80

TABLE II. HARDNESS OF A REPRESENTATIVE GROUP OF HIGH-SPEED-STEEL TWIST DRILLS.

The method of conducting the drilling tests was according to ordinary shop-drilling conditions. Therefore, the results have a greater value than if they had been obtained from laboratory conditions.

Scleroscope readings were uniformly taken by clamping the drill between copper jaws in a vise and mounting the scleroscope on a swinging bracket provided for that purpose. It is interesting to note that, although over 1000 scleroscope readings were taken with the instrument, the small testing hammer did not change in the value of its readings

UNIFORMITY OF DRILL HARDNESS

A comparison of the scleroscope readings for hardness shows a surprising uniformity between the individual drills in each of the various groups that were investigated. Six series of high-speed-steel drills were thus tested. The results are shown in the accompanying tabulation, Table I. As this tabulation is considered, it should be borne in mind that high-speed steel is notoriously lacking in uniformity of composition and characteristics. This lack of uniformity is one of the difficulties in the production of high-speed-steel twist drills.

Another series, indicated as series 7, was tested, which contained ten 11/16-inch carbon drills. The maximum variation in hardness between the hardest and softest drill of this group was only six points, as measured by the scleroscope scale. Still more interesting figures are presented by Tables II, III and IV. Aside from the uniformity of hardness throughout each group, it is interesting to note that the carbon-steel drills average higher in hardness than the high-speed-steel drills. The average hardness from Table II is 86 for the high-speed-steel drills; a similar quantity for the carbon-steel drills is 89. See Table III.

DRILLING TESTS

A preliminary drilling test was made with drills Nos. 3, 4, 7, 14 and 18; the hardness of each is shown in Table II. The results, however, were of such a nature that they were thrown out of consideration. The reason for this was the character of the material that was drilled. This material was flat bar iron, and on examination it was found to have hard spots and sand seams that dulled the point of the drill before comparative results were obtained. Table V shows the number of holes that each one of these drills made between the time of starting drilling, with the condition of the drill as received from the stock room, and the time when it was dulled sufficiently to demand the first grinding. The results are in no way indicative of what high-speed steel will do, neither are they in any way comparable with the other tabulated data in this article. The reason for putting them in is to show by a general comparison with the results of the successful drilling tests how easy it is to have experimental results vitiated by improper conditions. The material that was used for the successful drilling tests was, as we have stated, annealed tool steel. This material was determined upon because of its general uniformity of density and hardness and because it represents as difficult drilling as the average machine shop has to deal with.

Drill Number.	Hardness on the Scleroscope Scale.
47	88
50	93
51	93
54	87
55	86

TABLE III. HARDNESS OF A REPRESENTATIVE GROUP OF CARBON-STEEL TWIST DRILLS.

Drill Number.	Hardness on the Scleroscope Scale.
44	94
45	87

TABLE IV. HARDNESS OF SEMI-HIGH-SPEED-STEEL TWIST DRILLS.

The results of drilling tests that are in direct comparison are given in Tables VI and VII. Table VI deals with carbon-steel drills and Table VII with high-speed steel drills. The very much larger number of holes drilled by the high-speed steel drills as compared with carbon-steel drills is the striking feature in these two tables. The average number of holes from Table VI is 15. The average number of holes from Table VII is 853; thus the average number of holes drilled by the high-speed steel drills is 57 times the average number drilled by a carbon drill. The smaller number drilled by a high-speed-steel twist drill, 627, is 42 times as many as the average of the carbon-steel drills. If we consider drill No. 31 its performance is 72 times that of the average of the carbon-steel drills.

Putting the figures in another way the average performance of the carbon-steel drills was 11 inches of metal drilled. Similarly, the performance of drill No. 38 was 471 inches of metal, of drill No. 31, 810 inches of metal giving an average for the high-speed-steel drills of 639 inches, or some 53 feet.

The hardness of the metal drilled in each case was practically the same. For all of the carbon-steel drills listed in Table VI the hardness of the annealed tool steel that was drilled through was 31 by the scleroscope scale. Two lots of steel were used in testing the high-speed-steel drills Nos. 31 and 38. One lot tested 29 and the other 32½ by the scleroscope scale. The average of these two hardnesses, 30¾, is practically the same as the 31 for the material cut by the carbon drills.

An experiment made to determine the effect of reheating on a high-speed-steel twist drill gave interesting results.

Drill Number.	Hardness Number.	Number of Holes Drilled.
3	86	5½
4	81	120½
7	87	33½
14	84	5
18	83	26½

TABLE V. RESULTS OF A PRELIMINARY DRILLING TEST WITH 11/16-INCH HIGH-SPEED-STEEL TWIST DRILLS.

The drill was originally very hard, measuring 95 on a scleroscope scale, and extremely tough. It was heated to about 2200 degrees Fahrenheit and rehardened in heavy cylinder oil. Its hardness remained unchanged and was still 95. It was apparently as tough as before.

It was then reheated to a low, red heat and tested with a scleroscope while still red. It showed 70 hard, or plenty hard enough to cut soft steel. It was then allowed to cool naturally and remeasured with the scleroscope. It still had its original hardness of 95 and was still extremely tough. However, the end of the piece which was not rehardened from the temperature of 2200 degrees Fahrenheit had lost some of its hardness for it measured 70 when cold.

Conclusions

In our opening paragraph we stated the purpose of these tests in the form of two questions. The first one, that relating to the relative drilling capacity of carbon-steel drills and high-speed-steel drills, we are able to answer within the limitation of our experiments. The second, which related to the influence of hardness as measured by the scleroscope upon the drilling qualities of drills, we are unable to answer. However, by referring to Table VII it will be noticed that drill 31 which drilled 1079 holes was 9 points harder than drill 38 which drilled 627 holes.

Drill Number.	Hardness Number.	Number of Holes Drilled.
47	88	10
50	93	24
51	93	5½
54	87	11
55	86	14

TABLE VI. RESULTS OF A DRILLING TEST WITH 11/16-INCH CARBON-STEEL TWIST DRILLS.

Drill Number.	Hardness Number.	Number of Holes Drilled.
31	89	1079
38	80	627

TABLE VII. RESULTS OF DRILLING TESTS WITH 1/16-INCH HIGH-SPEED-STEEL TWIST DRILLS.

Effect of Reheating on a High-speed-steel Twist Drill

These two drills were respectively the hardest and softest of those selected and listed in Table II. If this element of hardness as determined by the scleroscope scale is a determining factor in the drilling performance of drills, we would expect all of the other drills listed in Table II to drill, under the same conditions, a number of holes that would fall between the limits of 627 and 1079.

Two general facts are clearly indicated by the results: First, the enormous drilling capacity of high-speed-steel twist drills over that of carbon-steel twist drills. This fact is well known qualitatively though not quantitatively. The second, that the hardness of properly tempered high-speed-steel twist drills is lower than that of correspondingly properly tempered carbon-steel twist drills, is not well known. Ignorance of this latter fact has caused drill users to return high-speed-steel drills to the makers with the complaint that they were too soft when in reality they were properly tempered. This idea was probably obtained from a comparison with carbon drills. As we have pointed out, the average hardness of the high-speed-steel drills listed in Table II is 87, as compared with an average hardness of 89 for the carbon drills in Table IV. The practical experience of Messrs. Lincoln and Williams fully bears out this conclusion, that properly tempered high-speed-steel twist drills are softer than correspondingly properly tempered carbon-steel drills.

In selecting high-speed steel from which twist drills are to be made, it is probable that a grade which does not get excessively hard, say not over 90 on a scleroscope scale, but is very tough is more suitable than a steel that will harden to a higher degree. The softer kind will have more tungsten and less carbon and chromium and will, therefore, not suffer temper drawing to the extent that will prevail with the harder steel.

How Should a Boy Go About Becoming a Mechanical Engineer?

By James Watt

I have a boy of 14 who imagines he wants to be a mechanical engineer. Among my acquaintances there are several mechanical engineers.

A (a graduate of an Eastern college) says: "Let him go to college first and then work in the shops afterward."

B (a practical man) says: "Let him serve his apprenticeship first and then go to college."

A says: "A mechanical engineer need not know the little things, for instance, how long it ought to take to turn, or plane, or bore a certain job, or whether it is cheaper or better to finish a piece in the milling machine, or on the shaper, or planer."

B says: "A mechanical engineer should know these things and be able to say, this job should be milled; that one planed; the other is better handled in a boring mill than in a lathe."

A says: "Estimating is an exact science."

B says: "Estimating is guessing, and the best guesser is the best estimator; that the ability to guess correctly is based, not on a thorough knowledge of the higher mathematics, but on a thorough knowledge of the various operations and costs of materials, together with a couple of other guesses, how much will the other bids be, and how much is the customer willing to pay; that knowledge of operations, i.e., milling, planing, shaping, lathe work, etc., is gained by actual experience only."

A says: "Records of work done are of more value in estimating than actual experience."

B says: "This is true to a certain extent, but how about new jobs or shops where there are no records?"

I put this up to the readers of the American Machinist to answer.

An Important Electrical Works of Germany

Interesting Arrangement, Equipment, Special Tools, Testing Appliances and Floor-plate Construction of the Frankfurt-Lahmeyer Works

BY J. B. VAN BRUSSEL

The Frankfort-Lahmeyer Works is one of the important electrical manufacturing plants of Germany. Its specialty is the construction of all kinds of electrical machinery and its accessories. The plant employs about 4000 hands, and during the year 1907 produced nearly 10,000 machines and transformers, having a total aggregate horsepower of something over 400,000.

There are two main machine shops, known as A and B. Each is 280 feet long and 101 feet wide, with an arrangement of main floor and side galleries, as shown in the illustrations, Figs. 1, 2 and 4. Of these illustrations Figs. 1 and 4 show sections of building A, while Fig. 2 shows a part of building B.

Special Machine Tools

Many special machine tools are used for machining operations on the large parts of slow-speed generators and alternators. One such machine tool is a slot-milling machine for large armature cores. It has three sets of tool holders arranged at angles of 120 degrees, feeding vertically, and each is provided with two milling cutters.

In the foreground, at the right hand of Fig. 2, is seen a large magnet frame on edge, and a portable drilling machine in the operation of drilling holes for attaching the pole pieces. In the center of this same view can be seen a large magnet frame lying on its side and within it a smaller magnet frame that is being operated upon by a portable machine tool. A study of the picture will show various other portable machine tools scattered throughout the floor.

Another interesting feature of this illustration is the extensive floor-plate construction. This is composed of heavy continuous cast-iron plates provided with T-slots, and is available for the holding down of castings to be machined, portable machine tools, or for machines in the process of erection, or testing. Fig. 4, which shows a section of the testing floor, presents another type of floor-plate construction, composed of structural-steel sections placed back to back, set in a concrete floor body and so arranged that the space between the steel members can be utilized for fastening machinery by inserting bolts in any position desired. These floor-plate constructions are very expensive and have been worked out with much detail.

Several interesting features are shown in Fig. 1. In the foreground are four jib cranes supported entirely from the floor and having neither bracing nor guys. The trolley is provided with a single wheel that runs on the top of the I-beam of the

FIG. 1. THE GENERAL MACHINE FLOOR OF THE FRANKFORT-LAHMEYER WORKS

crane, instead of having a pair of wheels that run on flanges, the ordinary construction in America. At the left of this view is seen a swinging jib fastened to one of the columns of the building. This is of the same simple type as the other jib cranes that we have just mentioned. About midway of the view on the left can be seen a laying-out table with some work in position. This table, as will be noted, is served by a gantry crane. The type and arrangement of the large machine tools on this floor are shown plainly. Near the lower right-hand corner is an interesting article of factory equipment, in the shape of a drinking fountain provided with six faucets.

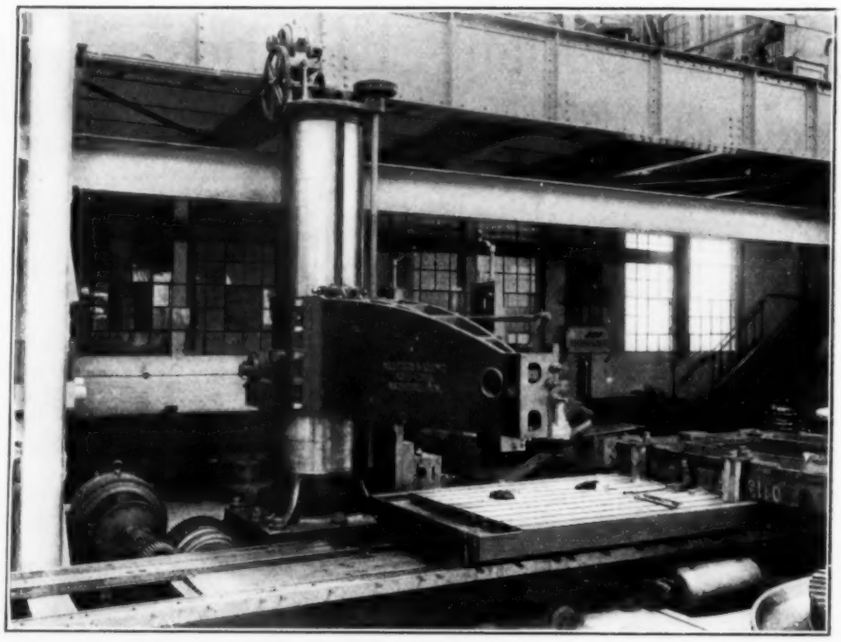


FIG. 3. A LARGE GERMAN OPEN-SIDE PLANER AT THE LAHMEYER WORKS

Extent of the Plant

In addition to the two main machine-shop buildings, *A* and *B*, there is a shop *C*, used for the fitting and erecting of the medium sized motors, generators and motor-generator sets, and for the machining of the smaller parts of the large slow-speed alternators. Shop *D*, which is connected with shop *C*, is used chiefly for the construction of turbine-driven generators. Shop *E* is given over to the manufacture of electrical instruments, and shops *F* and *G* are used for the manufacture of small machines. The firm has no iron or steel foundry, buying such castings outside. However, it melts its own copper and brass.

All machine tools throughout the plant are electrically driven, the larger ones by individual motors and the smaller ones arranged in groups for group driving. Two kinds of current are available at all points in the plant for power purposes; namely, continuous and alternating. Thus any

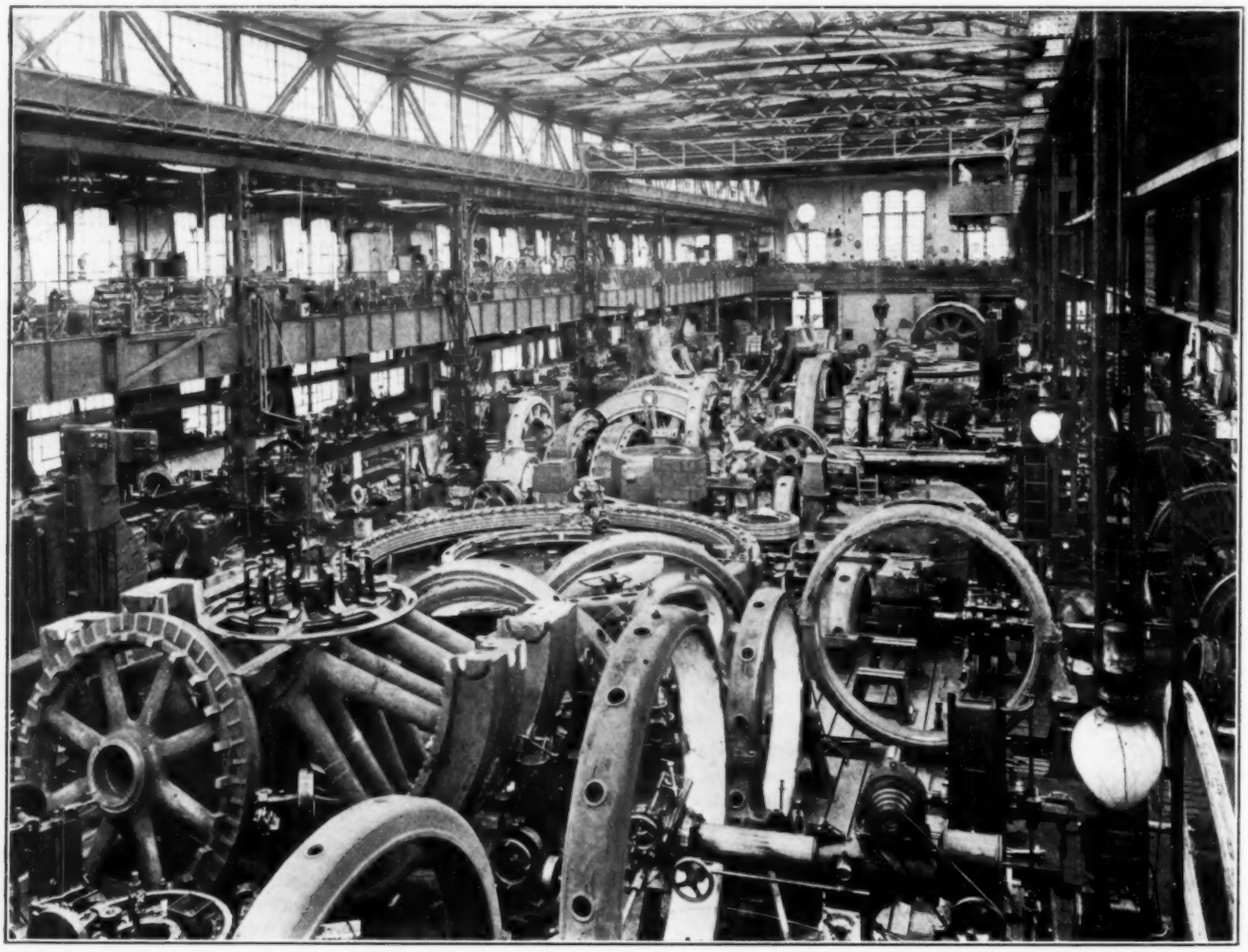


FIG. 2. MACHINING OF LARGE SLOW-SPEED ALTERNATOR FRAMES AT THE FRANKFORT-LAHMEYER WORKS

machine tool can be provided with a constant speed or variable-speed motor as the work which it is to do demands. In all 380 electric motors are used, aggregating 1600 horsepower, thus giving an average of less than 5 horsepower per motor.

A Large Open-side Planer

Fig. 3 shows a large open-side planer built by the firm of Billeter & Klunz and located in shop *C*. It has a platen 19 feet 8 inches in length by 5 feet 9 inches in width and the cross rail can be raised to clear work 5 feet 9 inches high. An interesting feature of its construction is the flat ways that differ from the V-ways of American practice. This planer is driven by an electric motor as seen at the left-hand of the illustration. Between this motor and the driving gear is a magnetic clutch. Many clutches of this type are in use on the large machine tools throughout this plant. They were designed and built at the works.

Each clutch consists of two mushroom-shaped magnet cases mounted horizontally with a common circular armature between their heads. The casings contain the exciting or magnet coils. The clearance between the magnet heads and the armature on each side is about ⅛ of an inch. The head of each magnet case is provided with a loose ring fitted on its outer face, that is, the face toward the armature, with a series of flat circular blocks of hardwood. These blocks form the friction surface and are so secured that they can be replaced easily. The rings and faces turn loose on the steel casing and friction, or the driving force, is exerted both on its inner face against the steel casing, and on its outer face between the wooden blocks and the armature.

Lead and Pitch

By E. T. Strong

A machinist friend of mine came in to see me a few days ago and said: "Have you any authority on thread cutting or worm cutting? I am in trouble trying to prove that the pitch of a screw or worm and the lead are different. I know they are when it comes to multiple threads, but I can't find anything to prove it, and nothing else will do."

I told him he was right and offered to furnish him the necessary evidence, so after a few days he came again, and I had not yet found the author we were looking for. I had access to the library of one of our best universities, and from such works as contained therein, could prove that the *pitch* was the number of turns per inch, and that was all. Nothing was said about the term *lead*.

I was somewhat disappointed in this, as I was sure I had seen the positive statement defining these terms. After this experience I went to consulting my files of the American Machinist from 1904. In an article on "Worm Gear Design," by A. M. Sosa, this statement is found: "The lead for single thread is equal to the pitch; for double thread it is equal to twice the pitch, and so on." This came nearer being what I was looking for than anything else I could find in subsequent issues. The result of this search on my part has gotten me interested and I am led to ask for a settlement of it in the American Machinist.

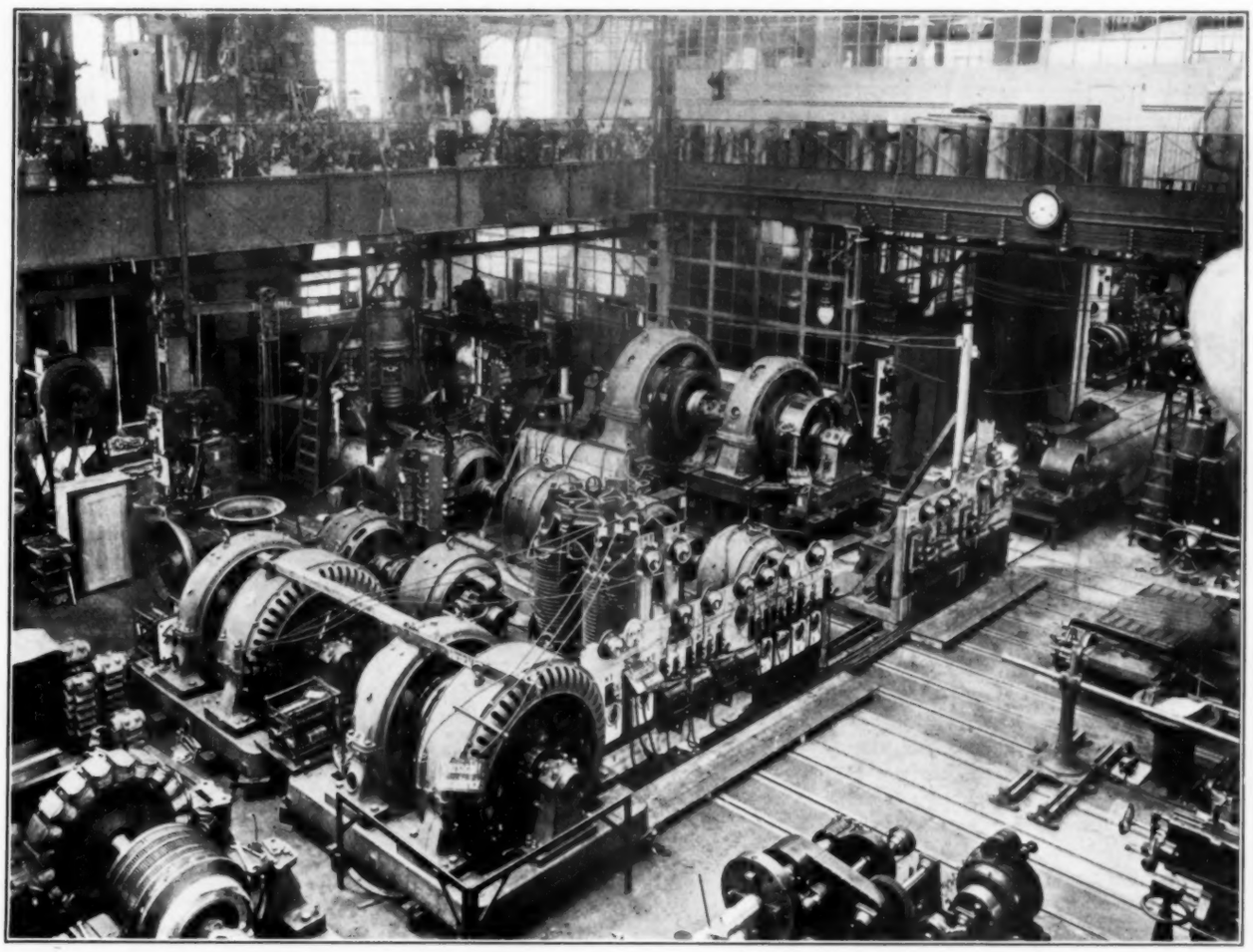


FIG. 4. MAIN TESTING FLOOR OF THE LAHMEYER WORKS

[There is undoubtedly a good deal of confusion in the use of the terms lead and pitch. The best practice, which deserves to become universal, is to define *lead* as meaning the advance between two complete turns of each thread of a screw and *pitch* as meaning the distance between adjacent threads. In the case of single-thread screws the two terms reduce to the same meaning, and either may be used; but with multiple-thread screws, where only confusion can arise, the terms should be used as above defined.—Ed.]

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Fixture for Finish Threading Taps with Dies

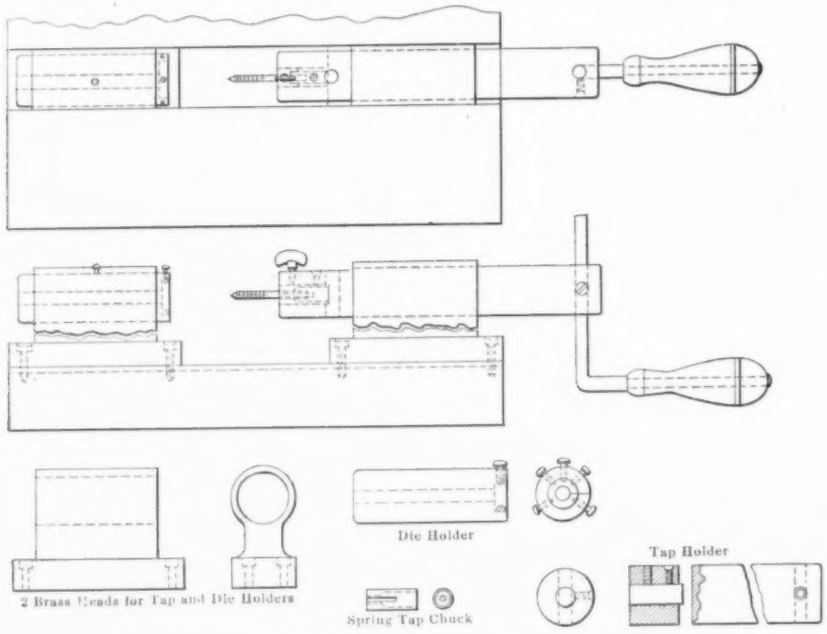
Everyone who has had any experience in making small-sized taps by the die method, that is, by means of the roughing and finishing dies, knows how difficult it is to get the first threads of the tap with the proper pitch when running the finishing die on by hand; it is impossible to start the die perfectly square and true with the tap, and the conseuqence is that the first threads on the tap are not accurate. This causes a great deal of trouble such as the breaking and bending of taps. The fixture shown will overcome these difficulties and is quite simple.

The base is made out of a piece of cast iron 10x5 inches by 1½ inches thick, with a groove 1¼ inches wide through the center of the block in which the spindle heads set. The hole in the tap and die housings should be bored and lined up accurately. The die holder is made of cold-rolled steel 1 inch diameter, 3 inches long, with one end drilled out like a common die holder. This hole is made the same as a common die holder with allowance for opening and closing of the dies. The die holder is fitted into the housing and held in place with a set screw.

The tap holder is also of cold-rolled steel 1 inch diameter and 6½ inches long. In one end a ⅜-inch hole is drilled 1 inch deep in which a chuck is fitted. This chuck is made of tool steel ⅜ inch diameter by 1 inch long. A ¼-inch hole is drilled in one end ¾ inch deep; another hole the size of the tap is drilled in the other end, and from this end and through the center a slot 1/32 inch wide is sawed through the piece for a distance of ⅝ inch for the spring of the chuck.

The chuck is held in place by means of a set screw through the tap holder on the back end of the chuck and tightened by means of a thumb screw through the outside spindle ¼ inch from the end. The handle is made so that it may be adjusted to any radius desired. When the die has been alined with the tap the pitch on the tap is correct from the first thread and the taps can be threaded a great deal faster than by running the die on by hand.

Hartford, Conn. W. H. DEACON.

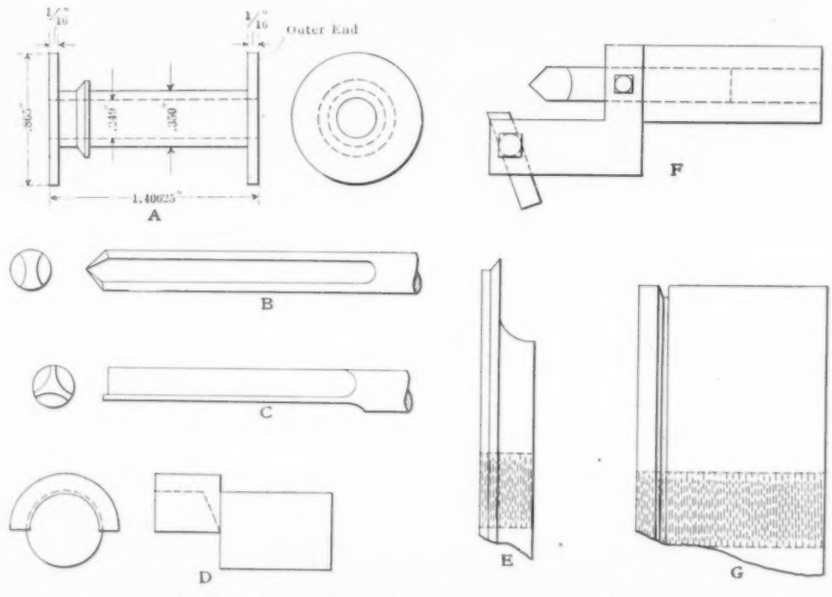


TAP THREADING FIXTURE

An Automatic Screw Machine Job

The sketch *A* shows the part to be made which is of unusual proportions. It might be considered unreasonable to expect that such a small diameter of body would stand the pressure of the wide-faced forming tool without chattering, bending, or breaking off, or that the outside would run true with the hole. We are given no limit in the hole which must be 0.249 inch, and reamed; on the body we have 0.003 limit. The flange must be straight and smooth. The machine used is a No. 2 Brown & Sharpe with six holes in the turret. Knowing what the work requirements are, we proceed to figure out what is required in the way of tools.

The operator prefers to feed the stock to a stop, and in most cases he gets it, but, when we require all the holes for



AN AUTOMATIC SCREW MACHINE JOB AND TOOLS

other tools we feed the stock the required length without a stop. The first tool centers the work so that the drill *B* can get a true start. The hole is considered deep, so we drill and back out to clear out chips and oil the drill, or use two drills. The reamer must be one to cut a true hole. From experience we chose a three-lip reamer *C*, allowing one lip to do the cutting by grinding the other two back about 1/32 inch, and using them to support the one doing the cutting.

If this reamer gets a true start, it will give a straight true hole. It acts exactly as a lathe boring tool. We next consider the forming tool and decide that the stock will spring away from the tool while cutting unless we use a support in the turret. As the stock is ⅞-inch brass and sometimes a few thousandths over or under size, also not straight, we cannot use the support on the rough stock, so it has to be trued up, else the outside would not run true with the hole. The flange is only 1/16 of an inch thick, and as a support bearing on this would rub the edges over and reduce the diameter, making the support of no use, we feed the stock out about ⅛ inch longer than the finished piece, giving 3/16-inch face for the rest to bear on. The support preferred, as shown at *D*, is half round, the size of the stock after truing up, and is made to be used in a floating holder to help the operator to line it up. The diameter of both flanges have to be turned to size and the ⅛-inch surplus stock faced off. For this we use a box tool, one cutter turning the first flange, then moving rapidly to the second one and during the operation on this flange facing the end. The body being small we use a back rest on the first flange ahead of the second tool. The cutting-off tool is a regular circular tool *E*, for brass.

The order of operations follows: Feed stock 1⅝ inch, turn ¼ inch, and center with tool *F*. Drill 1 inch deep with straight fluted drill *B*. Drill full depth with second drill, using high-speed drilling attachment on both drills. Form with tool *G*, having face and both sides ground straight and smooth, at the same time supporting stock from turret with *D*. Then comes the reamer *C*, which is lined up in a floating holder, and given a slow feed to insure a true start; at the same time the cutting-off tool *E* can be working, but the reamer must, of course, be out of the hole before the piece drops off.

We used the forming tool on the front slide and got a job to be proud of. The chips rolled up in long strips for nearly the whole depth cut, showing a nice, steady feed. The spindle speed used was 1200; the output was 300 in 10 hours.

W. M. McKENZIE.

New Rochelle, N. Y.

An Old Haystack Boiler

Fig. 1 shows a haystack boiler composed of five tiers of 108 plates, there being 21 plates in each tier and one round plate 30 inches diameter at the crown and two plates forming a 4-foot circle for the top of the firebox. There are 21 plates nicely bent all exactly alike to form the bottom ring which rests on a brick foundation. The greater part of these plates have been repaired by some 20 patches. The bottom plates appear to have been 5/16 inch thick and the side plates ⅜ or 7/16 inch thick. The rivets are all 2-inch pitch single riveted throughout. It is provided with a safety valve, a cock is provided for the feed water which is threaded 1½ inches pipe size and is placed about 3 feet from the bottom on one side. There is a manhole in the top or dome, but I do not see any sign of gage cocks or water gage. There is not a single square or flat plate and it must have required a great amount of skill and labor to build it. I consider it a boilermaker's masterpiece. It was used for many years to drive a beam engine fitted with parallel motion, cast-iron connecting rod and square cast-iron crank shaft. The flywheel had a square hole about 2 inches larger than shaft and was fitted with 16 wrought-iron and wood wedges. The engine is the same as James Watt's, of 1784, and was used for driving a flour mill. The haystack boiler has been superseded by the well known type of egg-ended boiler of which there are great numbers in this district.

FIG. 1. AN OLD HAYSTACK BOILER

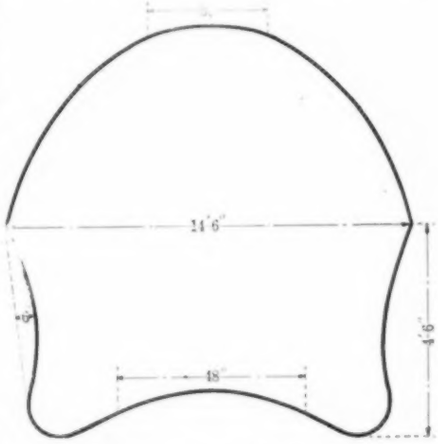


FIG. 2. OUTLINE OF BOILER

Fig. 2 shows the outline of the boiler. There are no stays in it.

Darlston, England. H. MAPLETHORPE.

Should Not Technical-school Shop Courses be Reversed?

I had occasion recently to look through the catalogs of several of our technical colleges and to examine the prescribed courses in mechanical engineering. My interest was centered particularly on their shop training. In each case the shop work started in the wood room and passed through foundry, forge shop, and machine shop. In some cases the whole amount of work in one branch was completed and the student then passed to the next branch; in others the different branches were mixed together so that the student got a taste of two or more during a single year.

As a graduate of one of the latter class of institutions, and as an engineer of more than ten years' experience it seems to me that the shop work of all our engineering colleges is laid out backward. Does it not require greater judgment, more skill and more ability to think, to take the product of one man's brain as shown on paper and to properly conceive this representation, to reproduce this conception in wood, to provide for prop-

erly supporting the cores and to allow for shrinkage, than it does to machine the finished casting or to grind work on a grinding machine to limits of 0.0005 inch error? Personally, I believe the average patternmaker to be a far better mechanic than the average machinist; that patternmaking requires a greater amount of education, a higher degree of intelligence and a greater skill in the use of hands than that required of a machinist.

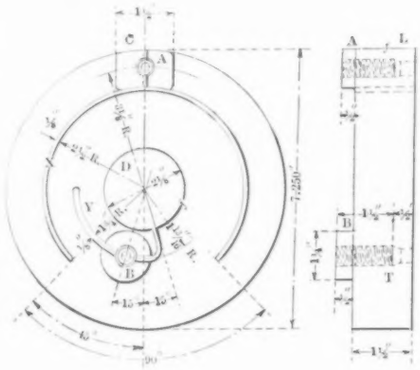
A like line of thought would also lead one to believe that the blacksmith was one ahead of the machinist. In passing through a forge shop one frequently admires the ease with which a man molds a piece of hot iron under the hammer; but have we not also seen the effects of misdirected effort, and the utter helplessness of a man when the skill and intelligence were lacking? We all know what a poorly managed foundry, filled with poor molders will not do. We also know that the patternmaker's product goes to the foundry and the kind of treatment it receives at the hands of the average molder.

If the above reasoning is correct the order of courses in shop work should be: First, machine shop; second, forge shop; third, foundry; and fourth, patternmaking. This would result in the student taking the subject requiring the most mature mind last in his course. I realize that this letter is little short of heresy and will have about the same effect on educators that running a stick into a hornet's nest has upon these insects. One thought more: Could not the time spent in the shops be spent to a greater advantage in visits to industrial establishments? If the salaries of instructors and the money spent for running the shops were devoted to a course of lectures by shop men, would the student not derive more benefit in his training for an engineer?

Berwick, Penn. C. R. HARRIS.

An Expanding and Contracting Bushing

The expanding and contracting bushing shown in the accompanying cut was designed for the purpose of lining up a small boring bar in a large hole which was already bored. The same idea has been used here in our shops in a number of similar places to good advantage and



AN EXPANDING AND CONTRACTING BUSHING

it may prove of use to other tool designers.

The ⅛-inch slots at *X* and *Y* are cored through the casting and bosses are built up at *A* and *B* to give the required length of thread for two taper pointed set screws.

The casting is sawed through at *C* and a set screw is put into the boss at *A*. Screwing the set screw down into the taper at *T* expands the bushing externally. The same arrangement at *B* expands it internally or contracts it onto the shaft of the boring bar.

The outside of the bushing and the hole at *D* should both be made as perfect fits as possible.

REUBEN BENJAMIN LOVEJOY.

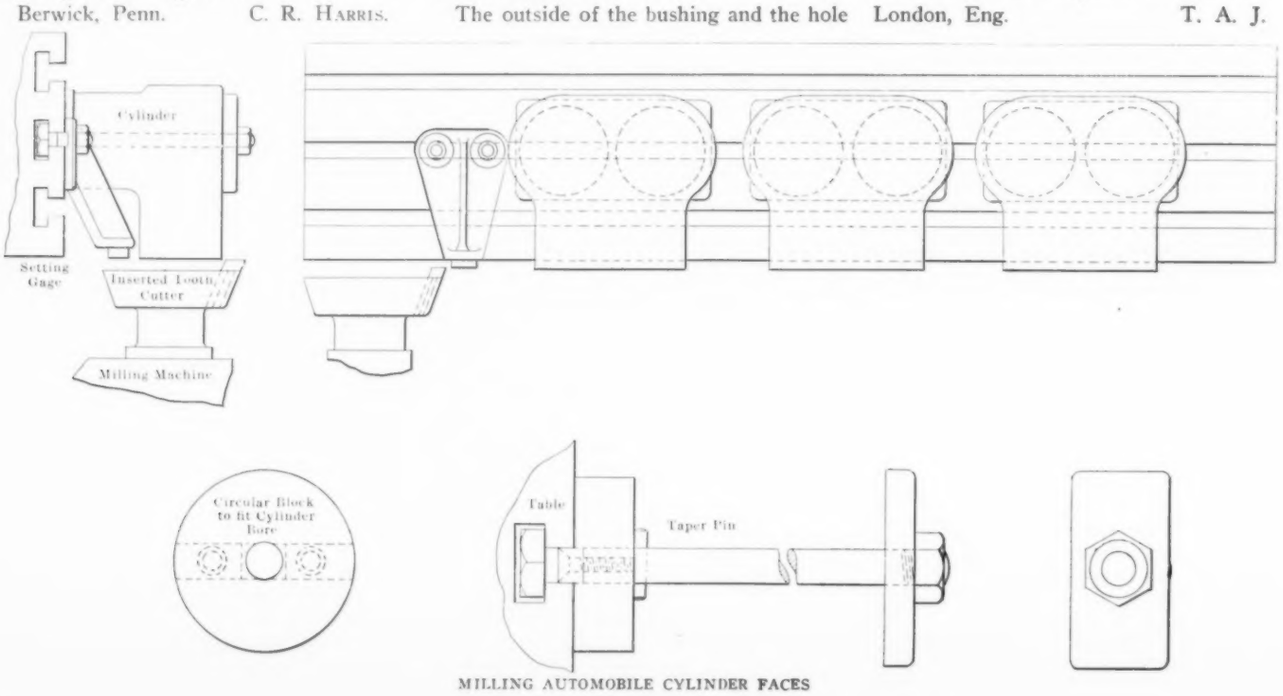
Washington, D. C.

Milling Automobile Cylinder Faces

The method shown herewith was devised for machining exhaust and induction faces of automobile cylinders which were machined in sets for six-cylinder cars. I have seen considerable trouble with leaking exhausts and induction faces admitting air, also exhaust pipes cracking after being bolted up, owing to the faces not being level.

The fixtures shown consist of six circular cast-iron blocks which are a good fit in the cylinders and which have cast-steel feathers let in to fit the slots in the milling-machine table; the blocks also have a hole through the center for a bolt, which goes through the cylinders and holds them down by a strap across the top. A cast-iron bracket (shown at the left) is fixed at the end, and this also has a steel feather fitting into the same slot as the circular blocks. A hardened-steel distance piece is let into the bracket, and this is rubbed over with chalk, so that in setting for the cut the inserted-tooth cutter just scrapes the chalk. A cut is then taken across all three cylinders and they are finished right away. Of course, the stop on the bracket is fixed at the correct distance from the center of the T-slot. The method is very satisfactory, and no laying out or measuring whatever is required.

London, Eng. T. A. J.



MILLING AUTOMOBILE CYLINDER FACES

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

The Personal Equation

The experiences of Sammy, as recounted by W. Osborne, at page 441 recall some equally disastrously good results, obtained by a boss, whom I had under me once. He was looking after the planer job. The "old man" had an idea that the best planer hand in the world was worth just $2.50 per day. We were running out of the hard times that followed the panic of 1893. The old man had been willing to pay his top price all the way through the depression, so we ran along very well until the other shops began to pick off our men. We could make no impression on the proprietor, so we did the only next best thing, and started to make planer hands.

Anybody that thinks four years too short to learn a trade ought to have seen that boss make planer hands. Six months made a man that could be trusted with all but a few of the jobs that we regularly had. The only trouble was, if we picked up a fellow that could get where we wanted him in six months, he would get in a year where some other shop wanted him more than the "old man" did, as evidenced by the money offered.

These boys were not really planer hands in one way; that is, they had not had a long enough experience so that they did things according to the principles of the work. They did jobs as they were told. When they went out into other shops they floundered about quite a little before they got into the game, but then they made good.

The reason why these fellows came along so fast, as near as I could size it up, was this: They were all boys who had worked for three or four years at something, not all in machine shops, but they had acquired the work habit. They were chaps who had found out how slow advancement was to a boy without a trade. And most of all we treated them like men and gave them a show; the first show that many of them had ever had. This boss was the kind of a man that never had any bother about learning the trade when he was young, and he never would recognize that there was anything difficult about it for others. He had absolute patience in showing any boy, but woe to the boy that wouldn't try. And they knew it.

Before long every shop in town got to thinking that we were just there as feeders for them. I tried to persuade our foreman that he was too liberal with his teaching, and tried to get him to shut off the supply when the boy got where he could do our work. I found him just as set in his ideas as the proprietor; perhaps a little more so, for I finally got permission to raise the rate till I held the men. About half a dozen of them are foremen in other shops now. They got started up and they could not be stopped.

Springfield, Mass. ENTROPY.

I was much interested in W. Osborne's article relating to Sammy's shop—"The Personal Equation." I have seen the same conditions existing in several shops and must say the outcome was about the same in each case. It requires a man that is both strong and flexible to introduce an elaborate system and keep the old employees. It takes time and patience to overcome the prejudice that will always arise to combat any change from old ways, that perhaps contain the individual pet schemes of nearly every employee.

It is evident that Charley's system is of the home-grown variety or he would not have had to depend on either his or the blacksmith's judgment. If proper forms were in use they would have told at all times the amount of material on hand, the amount on order, and to what work it was assigned. One object of system, if I understand it correctly, is to plan in advance, keep accurate records and increase output more than enough to compensate for the extra clerks that the system requires.

Any system, whether simple or complex, cannot be applied, even in homeopathic doses, with any chance of success, unless it has been very carefully planned in its complete form, and its errors eliminated as far as possible before the first dose is given. It is like waving a red rag before a wild bull to allow a man, who is purely an office man, to attempt to put in a system.

It is a difficult problem and Mr. Osborne's solution is correct if he couples his flexible man with a carefully thought-out, well-planned system. But one can rest assured that both are essential, and unless one has this combination, failure is before him. It is an easy thing to go mad on the subject and carry things so far that the cost will reach abnormal proportions. The perfect system is one that will, in combination with good management and loyal employees, produce goods at the lowest cost. I don't care whose system it is, but when you are looking for a ready-made system see that it can produce the above.

Philadelphia, Penn. JIM GIMLET.

Round versus Square Tool Posts

Your correspondent, J. H. Thompson, on page 368, seems to be an advocate of the square type of tool post, in preference to the more popular, and certainly more handy and efficient round type with central clamping screw. He says, "the subject has not received the attention of designers, which is due to its importance." If he had read the columns of the AMERICAN MACHINIST a few years ago he would have learned more on the subject, as the tool-post question was thoroughly thrashed out then, and it is now a case of the survival of the fittest. The round type has practically swept the more clumsy and obsolete type off the market, and no wonder, considering its points of superiority. Ask any operator who has used both types, and he will soon tell you which he pins his faith to.

Of all the advantages which your correspondent cites in favor of the square type, not a single one can be sustained upon investigation. For instance, he says, that when a facing tool is taken out of a round tool holder, it cannot be set in exactly the same position, as quickly as it can in a square one, of the rigid type. This is altogether wrong, as he will soon find out if he takes the trouble to try, and although the square type cannot swivel round, yet the operator cannot take a tool out, and replace it in exactly the same position as before without a bit of maneuvering. In fact it is more difficult to set than in a round tool holder, as with the latter, a slight tap generally suffices to bring it to the requisite angle. With the square type, you have two small screws to secure the tool in position. If these do not tend to crack the top of the T-slot, in the compound rest, they certainly act as a screw-jack, and force the top lug of the tool post off in time, and moreover, very frequently break themselves off in the hole, and have to be drilled out. This is a fact, unless the tool posts are made very heavy and clumsy.

Your correspondent says that the square type has a larger surface in contact with the top of the rest, and is, therefore, held more rigid. The opposite is the case, for although the square type may be slightly larger in sectional area,

yet there is a large packing washer on every round tool post, for resting the packing piece on, and the surface of this washer in contact with the rest is nearly double that of the square type, which has a very narrow strip only on each side of the T-slot. The American builders of capstan lathes were quick to recognize this some years ago, and it is chiefly due to these little refinements that their machines command such a preference over our English-built lathes on this side of the water.

I feel sure if your correspondent knew more of the subject, he would not write championing the square tool post, as it is not near so handy as the round type with central clamping screw, which seems to be the accepted practice of most of the leading capstan lathe builders today.

Oldham, England. R. SAMUELS.

Rigidity Test of a 24x24-inch x 8-foot Planer

I read Mr. Pratt's paper on a planer test, on page 545, and then I read Dixie's description of a very old planer, in the same number of the AMERICAN MACHINIST. Undoubtedly Dixie's planer vibrated enough to make the operator feel as though he had on a jag all the time, but strange to say, the old planer still lives after imparting this tired feeling to several generations. No, Mr. Pratt, the planer-shaft bearings will be worn out, the V's cut beyond recognition and the bright parts hammered up like the face of a cast-iron anvil's long before the vibrations as you found them in the planer which you tested will result in disaster.

Besides, if Mr. Pratt will discover a substance which is absolutely rigid, and if it were not too expensive, planer builders would be only too glad to comply with his plea for a "perfectly solid tool."

Does Mr. Pratt know that a planer built as nearly theoretically correct as possible would not plane some castings anywhere near practically true? If he had used the same care and pains to show how an operator should fasten his work and what shaped castings should be annealed, etc., to make the work come out true, he would have hit upon a weakness far more prevalent than inability to finish work true and cheaply owing to lack of rigidity.

Did the wires vibrate more than one-thousandth, and were the vibrations so rapid that owing to the inertia of the indicator needle it did not respond? Was that vibration constant? Was it diminished or intensified under a heavy or light cut, since there is more or less noise from heavy cuts? Did the tool itself spring? Were the lead-test lugs of equal density? Instead of the one-thousandth spring in the bull-gear shaft, did not the oil film squeeze down?

The bull-gear pinion shaft was not tested, yet it is one of the greatest sources of trouble. To test the upward spring of the cross-rail, a tool without top rake one would think was the proper thing.

Cleveland, Ohio. J. G. DORNBIRER.

Weights of Bar Steel

Referring to Mr. Parson's article on this same subject, on page 916, Volume 31, Part 1, I have a similar formula except that it is based on a pounds-per-cubic-foot weight for steel of 489.6 pounds. This factor is more exact than the one Mr. Parson used, 480 pounds.

The formula is:

$$\text{Weight per foot} = \frac{\text{Area of cross section in square inches}}{144} \times 489.6 = \text{cross section in square inches} \times 3.4.$$

$$\text{Weight per 100 feet} = \text{cross section} \times 340.$$

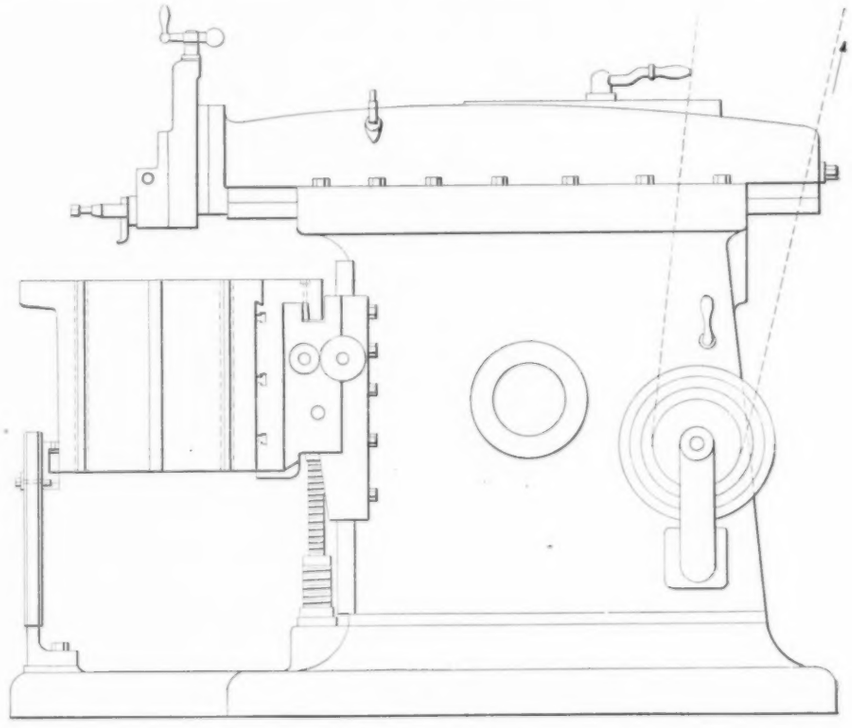
The area of any special size of circular section can be obtained readily from a table of circles in any handbook, and that of special shapes calculated. The formula requires the performance of only one simple multiplication when the area of the section is known. I made a table of the special sections which I use most frequently, and added a parallel column of weights per 100 inches. Then, to get the weight of material required per 100 parts, I needed only to get the length of the part, add the width of the cutoff tool, all in inches, and multiply by the weight per 100 inches from my table; the result is the weight per 100 parts required.

ARTHUR FREDERIC.

Philadelphia, Penn.

About Shaper Design

On page 315, Mr. McKee offers "Some Hints on Shaper Design." First, the table support shown herewith better answers his objection than his idea, because cast iron is five times stronger under compression than in tension. He would gain nothing, unless he went high enough to make his extension in the way of the operator, and even then the gain would be slight, unless he could tie the extreme top of table to the top of extension. The table support shown is self-alining, and when making vertical adjustment, it is only necessary to loosen and tighten the



ABOUT SHAPER DESIGN

cap screws that connect the table-support slide to its body.

Second, Mr. McKee would eliminate the saddle. From the standpoint of economy in manufacture, I agree with him; but users demand and often use T-slots in saddle. The method shown for attaching table to saddle is very rigid, and is self-alining, when table has been taken off and is again attached.

Third, Mr. McKee's idea of the gib in the front side of groove is not correct; he has an adjustment for original fit, but not for wear. In shaper shown, all gib screws can be reached without moving table back and forth, as he says.

Fourth, Mr. McKee's idea of the ram slide does not agree with mine, nor with the opinion of most practical men. I believe in the square slides because, when properly scraped to a box fit, there is no wedging, and no lift, except what is necessary in a running fit. The angle gib gives more chance for the ram to lift, and the

greater the angle the greater is this tendency; the slightest addition to this lift is objectional, as when cutting tool is out from column it is multiplied and affects the work the same as the dip of the table in the first example. In the cut shown, the cap screws have United States Standard heads and are located closer together at point of greatest strain.

Finally, Mr. McKee's ideas would undoubtedly increase the cost, except as noted, and shaper would not be as efficient. The cuts herewith are prepared from our regular foundation plans, and are not specially prepared for this article.

Cincinnati, O. A. W. WATCHER.

The Band Saw as a Machine Tool

An article, at page 543, on "The Band Saw as a Machine Tool," by Philip Bellows, reminds me: While in the tool room of a large manufacturing plant we used the band saw for cutting out templets of ⅛-inch brass, and also of soft-steel plate. The number of band saws used by this company in their manufacturing departments, on copper and brass, cutting sprues off castings, on mica and insulating materials of all descriptions, kept six automatic band-saw filing machines busy.

In another part of the factory we had a quantity of templets of ⅛-inch soft-sheet steel to make, male and female, a steady job keeping two and sometimes four toolmakers busy. These were cut out roughly by bench shears and chisel, leaving quite a job of straightening and more or less milling. One day I noticed in another part of the factory a small metal-cutting jig saw with a coil of about 50 feet of soft-back, hardened-teeth saw blade under the table. About 6 inches of it was in use. As it wore out you broke it off and pulled up a fresh length of blade and clamped it; quite a low-priced, simple, power saw. I found it was not being used, so had it set up in our section. It proved to be one of the handiest tools we had, and was in steady demand. We had three different widths of saw blades, and made an arrangement for holding them on the base of the machine, so that either width could be put in, in a moment to suit the work; 3/16- and ¼-inch were used mostly, with ⅛-inch for small curves. With a little practice a man would cut almost to the line.

Shortly after this the company put in a number of Brown & Sharpe automatics in the screw department, and we were busy for a time getting out cams from blanks of ⅝-inch soft steel. The first ones were drilled, milled and filed; quite a job. Trying them on the jig saw, we were surprised how closely we could cut and at the speed of the cut, considering the thickness. Finishing them on a small filing machine gave edges square with the face. We broke in an apprentice to do them in about one-third of the time taken by the old way.

Pittsburg, Penn. THOMAS A. DICKS.

The Grinding of Copper Rolls

I wish to thank Mr. Schliefer for calling attention, at page 463, to an error in my article under the above title, at page 133. The wheel used was a 46-grade, 3-elastic, the recommended speed being 4900 feet per minute, and the testing speed 8800 feet per minute, so the speed that it is used at (7300 feet per minute) would not be considered dangerous here considering the fact that the wheel was tested at 8800 feet.

Lowell, Mass. PAUL W. ABBOTT.

A Tack Driver

A similar tool for driving tacks as described by B. M. L. on page 241 has been

A TACK DRIVER

used by boot repairers for fastening loose heels on boots from the inside, but instead of being magnetized the tack is fed down the tube at the side of the plunger case then lift the plunger to let the tack pass the driver into the nozzle.

Northhampton, England. R. LETTS.

Balancing Grinding Wheels

Mr. Schliefer, on page 534, asks some wheelmaker to inform him if the constituent materials of abrasive wheels are such that the equilibrium of the wheel can be affected by temperature or atmospheric conditions. So far as the product of the company with which I am connected is concerned, the answer is: No. The pores of a wheel will absorb moisture, but except when a wheel is allowed to stand with part of its circumference in water, this does not affect its balance, nor does the moisture have any effect on the binding material. An elastic wheel may be temporarily softened by exposure to temperatures above 300 degrees Fahrenheit, but this temperature would be obtained only by the intentional application of artificial heat.

Where a wheel is found to be out of balance it is the custom of my company to slightly *underbalance* it, because a wheel fully balanced when new would be much overbalanced when worn down. I heartily subscribe to Mr. Schliefer's views regarding the desirability of every shop making provision to rebalance its wheels occasionally as they wear down. Some makers of grinding machines provide balancing weights in their wheel flanges, and all should do so. Perfect work can only be done when the wheel is nicely balanced, and this condition can only be assured when the balancing can be done after the wheel is mounted on its spindle.

H. A. RICHMOND,
President American Emery Wheel Works.

Providence, R. I.

Power Required by Cranes

In reply to Mr. Foote's notes, on page 316: When I submitted the diagram published on page 964, Volume 31, Part 1, I expected that the *form* of the diagram would be the interesting feature, rather than the formula. If one had the advantage of tests on the special design of crane with which he was connected then he could deduce the coefficients of friction, and work out his own formula.

In my case I adopted coefficients which are used by a firm of well known cranemakers, and the powers obtained have proved satisfactory in every case. The construction of the diagram from the formula is a very simple matter. The horsepower required to overcome rolling friction is small compared with the total, and is represented by the 0.7 in the formula

$$Horsepower = 0.0097 \frac{W\,S}{D}(d + 0.7),$$

where d = axle diameter at bearing, a small and uncertain quantity, and we might discard it. If we take Mr. Foote's tests we find that the coefficients of friction in the bearings are 0.051, 0.045, 0.014 and 0.024 in the four cases he gives. These figures for the slow speeds at which the bearings run are very low, and are so much at variance as to suggest that the cranes were of radically different construction. He gets tractive forces of 28.5, 25.5, 19.2, and 33.1 pounds per ton. Two cranemakers whose figures I have worked out allow 50 pounds for traveling and 120 pounds for cross-traveling. The higher figure for cross-traveling is necessary to make allowance for the smaller wheels.

It must not be forgotten, however, that the motor is required to frequently start the crane from rest and the time occupied in getting up to speed is of much importance. In an ordinary machine shop it would be better, for instance, to run the crane at 200 feet per minute rather than 400 feet per minute, having a lower gear and double the accelerating force. Mr. Foote is quite correct in his formula to overcome the axle friction, but in the second case in estimating that necessary to overcome rolling friction he omits to take into account the radius of the wheel, which is 18 inches, and the horsepower becomes

$$\frac{42.75}{18} = 2.37 \text{ instead of } 42.75.$$

I should like to point out that the value 0.035 is not the actual coefficient of rolling friction. The correct value is

$$\frac{0.035}{12} = 0.003.$$

The value 0.035 is taken so that we can work with the wheel diameter in inches instead of feet, as would be required when estimating the horsepower. Mr. Foote doubts the truth of the formula when it gives the power required as being inversely proportional to the wheel diameter. Since with a wheel half the diameter we get twice the revolutions for a given travel, the distance of rubbing on the bearing is doubled and consequently we get twice the resistance. I think this is very plain.

Erith, England. ALBERT D. HARRISON.

Ribbing of Cast-iron Beams

I can confirm Mr. Fish's conclusion, page 398, that the addition of a rib may weaken a structure.

Soon after being appointed chief of Messrs. J. I. Thornycraft & Co.'s steam engineering department it became my duty to investigate the cause of several failures of cylinder castings under hydraulic tests. I concluded that external ribs were at the root of the trouble, as the stress was higher in them than elsewhere. I had these removed and the trouble disappeared.

London, England. C. H. WINGFIELD.

Information on Die Work—Filing the American Machinist

On page 533, J. H. S. would like to know of methods to have different combinations of perforated holes in a blank in one die, and if the following description is of any value he can get good results thus:

Feed the stock four or more ways according to the number of different combinations desired. Pilots can be used in the scrap having special holes punched to guide by. A moment's study will show where gain is made when you want the outline of blanks to be exactly alike; besides, such a die will practically take the place of four dies. In the blank shown, Fig. 1, where a certain hole is to be had to work from on all four blanks, and one pilot will be accurate enough, excellent results can be obtained by having the pilot pin slightly larger than the largest hole, and have it a sliding fit in the punch with a stiff spring behind it so that it will not go through the solid stock if the operator gets his feed too far. The pilot pins with springs behind them do not break off and have the press operator spoil a run of parts before he finds out his pilot is gone.

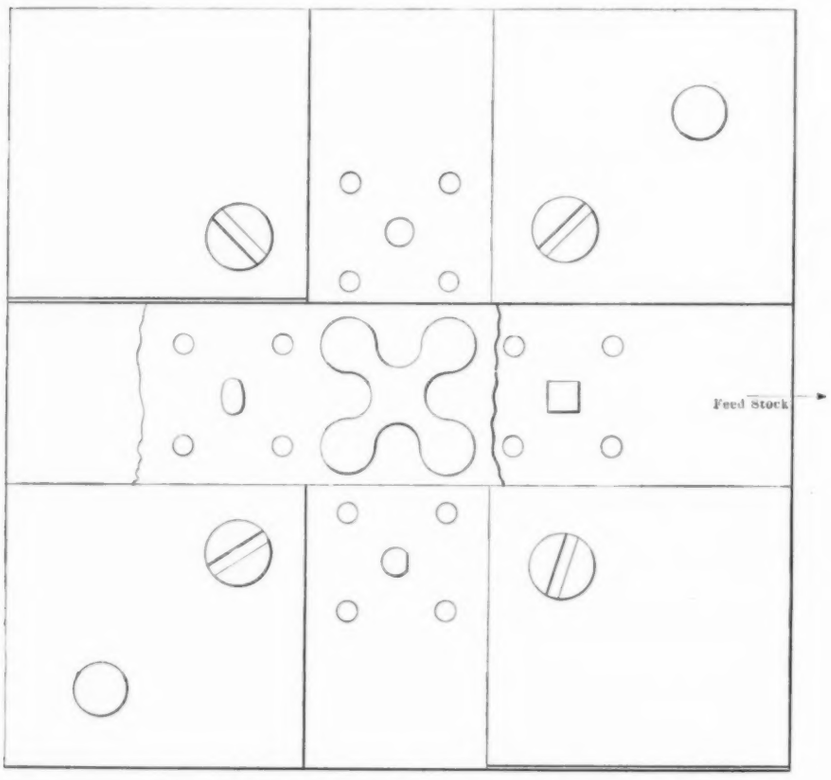


FIG. 1. DIE TO PIERCE FOUR COMBINATIONS OF HOLES

FIG. 2. PUNCH AND DIE FOR THE AMERICAN MACHINIST

I have used dies of this kind feeding stock three ways; two combinations can be had in any shape of blank without loss of stock in scrap. If your stops are properly arranged, no changing is necessary; four different styles of blanks can be obtained at the same setting of the die in the press, provided, of course, the press is of the open-back style.

On page 537, the article by L. C. Brooks particularly interested me, as I am in charge of the mechanical department of the Sieber & Trussell Loose Leaf Manufacturing Company, of St. Louis. Curiosity prompted me to try and see in how short a space of time any ordinary machinist should be able to make a ¼-inch punch and die to go through a complete copy of the AMERICAN MACHINIST. Fig. 2 shows the punch and die. Time, including hack-saw work, eight minutes. This die, soft, should punch 10,000 holes through ¼ inch of paper.

To get a good binder the following system is recommended: Take two pieces of ¼x3/32-inch stock 12 inches long and drill two holes about 7 inches apart. Tap out one pair of holes. Take two pieces of cold-rolled stock 3/16 inch diameter of suitable length. Thread down about three threads on one end and ½ inch on the other. Make two 3/16-inch nuts, and then your punch and die, and you will have a very substantial binder for your book free of cost to yourself, and the company you are with won't even notice it.

To just look up six months' of copies, the binder described is good enough for

most people, but your wife can easily sew on over the metal parts a very nice flexible cover of cloth or canvas, allowing about ¼ inch each way over sheet size. If you are not married, the rough binder first described will be good enough. If this seems to be too much labor, the S. & T. company makes a 12x9-inch screw binder, which retails at 65 cents.

St. Louis, Mo. T. E. H.

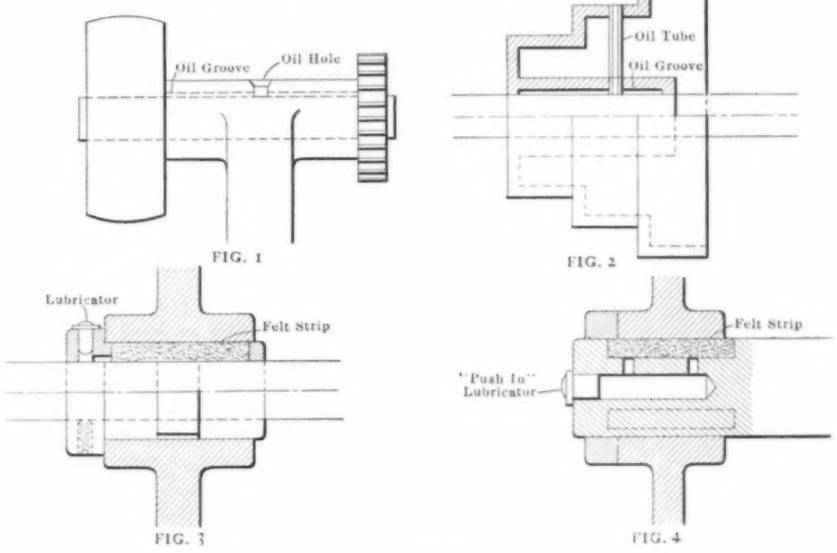
Loose Pulleys

While agreeing in the main with Mr. Baker's remarks at page 389, I am of the opinion that he is overrating the value of getting pressures perfectly balanced. While there is no reason for the one-sided arrangement in Mr. Noyes' milling-machine pulley, at the same time, given an efficient lubricating scheme—the oil hole or the boss appears to be better adapted for an oil excluder than an oil retainer—there is no reason why the same should not be perfectly efficient. Mr. Baker, in common with most designers, has no doubt been forced by exigencies of design to some such scheme as elaborated in Fig. 1 herewith, or to the cone pulley, Fig. 2 (lathe-spindle pulley for instance), on which the pressure can never be evenly distributed over the shaft bearing. Such arrangements are in common use and successful.

In my opinion the cause of abnormal wear, as suggested in Mr. Baker's Fig. 3 is due to inferior means of lubrication and poor material, rather than to the unbalanced pressures. As a rule, loose pulleys are provided with one small oil hole drilled through the hub into an oil groove running longitudinally through the hole. The groove serves to prevent the oil reaching the shaft at all when the pulley is running, even if it does not really conduct the oil to the oil hole from which it would fly on account of centrifugal force.

Some little time ago was tested the arrangement shown in Fig. 3. Running at 500 revolutions per minute a 12-inch pulley with 5-inch double belt—the hole being equal in length to the belt width only, this pulley need not be oiled more than once a fortnight. As will be seen the pulley rotates on a fixed bush (gray iron) containing one oil groove filled with felt strip. The advantage of this will be appreciated. The loose pulley can be oiled by pressing down the top of the push-down lubricator cover while the pulley is running.

A modification of this scheme is shown in Fig. 4, applicable to a pulley fitted to a shaft and as in Mr. Noyes' pulley machine. In this case it might be necessary to have three grooves and felt strips to insure getting sufficient lubrication, and personally I should prefer to have the pulley running on a gray-iron bush, as in Fig. 3, but lubricated through the shaft, as in Fig. 4.



LOOSE PULLEYS

MERIDEN CROSS.

Coventry, England.

Plugging Punched Holes in Sheet Metal Work

In answer to J. H. S. on page 533, would say that I find that when sheet metal blanks are to be formed it pays to punch as few holes as possible. The more holes the weaker the stock to be formed. Where I use a piece in combination I drill my die stripper and punch holder for the combination. Punch as many pieces as desired of one lot, then change the punches and get out the others. I have found that no matter how hard the blanks are crimped back in a hole that in forming they are bound to loosen up and will have to be crimped again after they are formed. At best it is a very slow and costly operation.

Erie, Penn. BERT SMITH.

Industrial Training in Montreal

I have taken pleasure in reading in the last few issues of the AMERICAN MACHINIST, about what is being done in different large centers to give a technical education to the artisan. I think it may be of interest to readers in general to know what we are doing in that respect in Montreal.

As yet our universities, McGill (English), and Laval (French), have not undertaken the problem of giving evening instruction to those who are employed during the day. We have here two separate and distinct school systems, Protestant and Roman Catholic. Each has its own board of commissioners, and both have established what are termed Commercial and Technical high schools.

In these technical high schools a boy is made acquainted with the different tools, their uses, abuses, etc.; in technical subjects and general school training. So that a boy, after leaving these schools to become a tradesman, has a fair elementary knowledge of what he is going at.

The Montreal Technical Institute, that has developed the technical evening classes of which I speak, is chartered by the Provincial Government of Quebec. The Protestant Board of School Commissioners has granted to this technical institute the free use of its magnificent new commercial and technical high-school building and its laboratory equipment. It also coöperates with them in conducting the evening classes.

In giving these evening classes the women have not been overlooked because there are classes in cooking, needlework and dressmaking.

The classes are for a term of 20 weeks. An entrance fee of $2 is charged, and in some cases, such as metalwork, an additional fee, not exceeding $3, is charged to cover the expense of material used. These classes are managed by a board of management chosen from both the Protestant Board of School Commissioners and the Montreal Technical Institute. Evening courses in mechanical drawing and other subjects are also given by the Y. M. C. A. and the Council of Arts and Manufactures, but they lack laboratory equipment.

This is the first year that these classes have been open, but the men of this city have been very quick to see the advantages of technical education along with their practical work, and the accommodations of the building are taxed to the overflow.

Montreal, Can. EDWARD A. BECK.

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British Regulations for Brass Foundries

On June 20 last the Secretary of State of Great Britain issued special regulations for the casting of brass; such regulations to go into force on January 1, 1910.

In general, the regulations seem to be somewhat drastic, although this feature is relieved by the granting of discretionary powers to the factory inspectors under certain circumstances. Such circumstances may arise from exceptional features in the construction or situation of the foundry, from infrequent pouring, from the pouring of a very small quantity of metal, or from the pouring of a special alloy. If these conditions prevail, the inspector may exempt the foundry from the carrying out of these regulations by issuing a special certificate.

The general trend of the regulations is to eliminate, or at least mitigate, the dangerous and unhealthy conditions that are believed to surround the melting and pouring of copper alloys. To that end they apply mainly to the number of cubic feet of air which must be provided in the foundry for each employee, to suitable arrangements for the inlet of fresh air and the removal of fumes from the melting pots and ladles, and to the providing of washing facilities for all of the employees. In regard to the unhealthfulness of brass foundry work *Engineering*, of London, states: . . . . "showed clearly that brass workers were particularly subject to diseases of the respiratory organs and that the malady known as 'brass founder's ague' was due to breathing the fumes given off by molten brass at the time of pouring, and also to some extent to the contamination of the worker's food by the fumes. As might also have been expected, the amount of mischief done was proportionate to the quantity of zinc in the alloy. It [report of Doctor Legge] showed clearly that brass workers are, as a class, considerably inferior physically to the general adult male population of the United Kingdom in respect to hight, weight and chest measurement. Among casters it was shown that those engaged in foundries where only a small amount of zinc was used in the alloy were in better physical condition than those who were employed where alloys were cast having a larger proportion of zinc."

The more important provisions of the regulations are: "1. The regulations shall not apply to a sand-casting shop having an air space equivalent to 2500 cubic feet for each of the persons employed, nor to any other casting shop having an air space equivalent to 3500 cubic feet for each of the persons employed. Provided; (a) that provision is made for the egress of fumes during casting by inlets below and outlets above of adequate size.

"2. So much of regulation 1 as requires that exhaust draft shall be maintained during the process of casting shall not apply in the case of strips or solid-drawn tube castings, or any other class of castings where the Secretary of State may certify on that behalf. Provided: (a) that the exhaust draft cannot be so maintained without damage to the metal; and (b) the exhaust draft is put into operation immediately after the casting; and (c) provision is made for the egress of fumes during casting by inlets below and outlets above of adequate size.

"3. Where it is proved to the satisfaction of the chief inspector of factories that by reason of exceptional features in the construction or situation of a casting shop, or by reason of the infrequency of casting, or the small amount or the nature of the composition of the metal cast, or other circumstances, all or any of the regulations are not necessary for the protection of persons employed, he may by a certificate in writing (which he may in his discretion revoke) exempt such casting shop from all or any of the provisions of the same, subject to such conditions as he may by such certificate prescribe.

"It shall be the duty of the occupier to observe Part 1 of the regulations and the conditions contained in any certificate of exemption. It shall be the duty of all persons employed to observe Part II of these regulations.

"Part 1. Casting of brass shall not be carried on unless the following conditions are complied with: (A) There shall be an efficient exhaust draft operated by means either of (1) a tube attached to the pot, or (2) a fixed or movable hood over the point where the casting takes place, or (3) a fan in the upper part of the casting shop, or (4) some other effectual contrivance for the prompt removal of the fumes from the casting shop and preventing their diffusion therein. The exhaust draft shall be applied as near to the point of origin of the fumes as is reasonably practicable, having regard to the requirements of the process, the maintenance of the exhaust draft during the process of casting, and (as regards casting shops in use prior to January 1, 1908) the structure of the premises and the cost of applying the exhaust draft in that manner. (B) There shall be efficient arrangements to prevent the fumes from entering any other room in the factory in which work is carried on. (C) There shall be free openings to the outside air, so placed as not to interfere with the efficiency of the exhaust draft.

"There shall be provided and maintained in a cleanly state and in good repair for the use of all persons employed a lavatory, under cover, (1) with a sufficient supply of clean towels, renewed daily, and soap and nail brushes; and (2) with either a trough with a smooth and impervious surface, fitted with a waste pipe without plug, and of such length as to allow at least two feet for every five employees and having a constant supply

of warm water from taps or jets above the trough at intervals of not more than two feet, or at least one lavatory basin to every five such persons, fitted with a waste pipe and plug, or placed in a trough having a waste pipe and having either a constant supply of hot and cold water or warm water laid on, or (if a constant supply of heated water be not reasonably practicable) a constant supply of cold water laid on, and a supply of hot water always at hand when required for use by persons employed.

"3. No female shall be allowed to work in any process whatever in any casting shop.

"Part II. No person employed shall leave the premises or partake of food without carefully washing his hands. No person employed shall carry on the pouring of brass without using apparatus provided in pursuance with Regulation I (a). No person employed shall in any way interfere without the knowledge and concurrence of the occupier or manager with the means provided for the removal of fumes."

New Publications

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. The 17th annual (1908) edition. 1240 7x10-inch pages. The S. E. Hendricks Company, New York City. Price, $10.

This edition of Hendricks' register is fully in keeping with those which have preceded it, and shows a satisfactory growth over the 1907 edition. While that edition required 76 pages to index it, this edition requires 82 pages. Each page contains 412 classifications, making a total for the 82 pages of 33,684 headings, each one of which represents the manufacturers, etc., of some machine, tool, apparatus, specialty, or material. The total number of addresses classified is upward of 350,000.

AMERICAN MACHINISTS' HANDBOOK AND DICTIONARY OF SHOP TERMS. By Fred H. Colvin and Frank A. Stanley. 512 4x6¾-inch pages, with numerous illustrations and tables. The Hill Publishing Company, New York and London. Price, $3.

There is an undoubted need for a book like this, which has been prepared by two of our associate editors. A glance through it will show that the cut-and-dried material which forms so large a part of existing handbooks, and which makes them, to a large extent, duplicates of one another, is here conspicuously absent. There are, of course, some things which must be included in any book of this character, but we believe there is none which duplicates others so little as this.

Books of this nature are the most difficult of all to review in a manner which will give an adequate idea of their contents, but, taking up the section on Screw Threads as an example, we find particulars with tables for the measurement of screw threads by means of the Brown & Sharpe gear-tooth, vernier caliper, with tables for the width of flat to be ground from a screw-cutting tool in order to give the United States standard thread, with similar tables for the Acme thread as it appears in both the finished screw and in the tap. We also find full particulars with tables for measuring screw-thread diameters with micrometers and wires, these tables covering United States standard, vee, Whitworth, Acme and Brown & Sharpe worm threads.

In the same section we find a table of angles to which to grind thread tools for side clearance; a table of change gears for diametral pitch worms; complete information, including tables, on the Briggs pipe-thread joints, showing the relations of reamers, taps, dies and gages, with particulars of testing and working allowances and standard gages; the Whitworth pipe thread and the national standard hose coupling. The bolt, nut and screw tables are unusually complete and include all standard and many special varieties, with the dimensions of numerous kinds of heads, including the new American Society of Mechanical Engineers' machine-screw details.

We cannot list the contents of the entire book as freely as we have the section on screw threads, but the same completeness characterizes the whole. We may, however, mention the table of drill feeds and speeds; the table of decimal equivalents of drill sizes in fractions of an inch, millimeter, wire gage and letter sizes arranged in the order of their size; a table of standard and stub-gear tooth parts; a table for sizing and cutting gear blanks; and a table for block indexing. Other tables give the form, number of flutes and type of cutter for milling all sizes of milling cutters, taps, hobs and reamers; the largest squares that can be milled from round stock; the setting of reamers and cutters for grinding proper clearance angles; hollow mill and spring-die dimensions; work feeds and speeds for all classes of screw-machine tools; punch and die allowances for various materials and the finding of shell-blank diameters. The section on calipering and fitting contains tables of limits; allowances in shop gages and caliper-play allowances for all classes of fits. The section on tapers contains not only those in general use, but also the Jarno, Reed and Sellers tapers, together with tables for finding the taper of work of different lengths and corresponding angles. The section on Shop and Drawing Room Standards includes dimensions of jig bushings, binding screws, straps, hand wheels, machine handles, standard plug and ring gages, counterbores, ball bearings, and a table for the division of circles for all numbers up to 500, the book concluding with a dictionary of shop terms which should have a large influence in bringing about a much desired uniformity in the use of these terms.

The book has been prepared by those who know what is wanted in a shop reference book. It is printed on high-quality paper and bound in flexible leather, and we believe that it will be found to be a companion of constant usefulness.

Personal*

George B. Massey, formerly treasurer of the Massey Machine Company, Watertown, N. Y., has recently become resident engineer of the Bucyrus Company, in charge of the New York office.

E. W. Goldschmidt, New York manager of the Wagner Electric Manufacturing Company, sailed November 6 on the White Star liner "Cretic" for Naples, expecting to remain abroad until the first of the year.

Hugh A. Brown, attached to the Chicago office of the Crocker-Wheeler Company for several years, has resigned his position in order to become manager of sales for the Rockaway Coaster Company, Cincinnati, in which he has an interest.

E. A. Ennis and E. J. Nelson, formerly with the Mergenthaler Linotype Company, as chief clerk and assistant chief clerk, respectively, have gone in business as factory systematizers and cost men, in Jersey City, under the firm name of Ennis & Nelson.

Loyd E. Shirley, formerly superintendent of the Hoosier Drill Company division of the American Seeding Machine Company, Inc., has severed his connection with that firm and has taken up the position of superintendent of works, the C. S. Bell Company, Hillsboro, Ohio.

Edward Robinson, professor of mechanical engineering at the University of Vermont, has secured a year's leave of absence which he purposes to largely spend in visiting different universities in this country and abroad, as well as some of the leading industrial works *en route*.

J. A. Kinkead has resigned his position as engineer of tests, American Locomotive Company, to become manager of sales for the Parkesburg Iron Company, Parkesburg, Penn., in the New York, New England and Canadian districts, with offices in the Singer building, New York City.

Obituary

John Schink, of Bridgeport, Conn., died recently as the victim of a senseless piece of "sport" in which his intestines were blown full of compressed air and ruptured. This is the second time that an occurrence of the kind has come to our notice and, while it should not be, it is, necessary to call attention to it.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Shafting Turning Machinery

This machinery is used for finishing shafting, bronze rods, tubing, etc., in all sizes from 1- to 6-inch, inclusive. It is installed in a large number of plants throughout the United States and Europe. The builders, the Brightman Manufacturing Company, of Shelby, Ohio, have recently designed and brought out additional shafting machinery to meet the demand of users who wish to install at their individual plants this class of machinery for their own exclusive use.

Fig. 1 shows the turning machine. The rough bar, tube or rod is fed in at the end by a set of feed rolls which are regulated by a four-step cone. The material is centered by a guide placed in front of rolls. It has a perpendicular adjustment, and the feed rolls make the other adjustment, which is horizontal. After leaving the feed rolls it enters the hollow cylinder through a bushing to the guide head. This guide head contains guides set in segmental slots, and having a screw adjustment. The material then passes to the cutter head inside the box. This cutter or finishing head turns material to size, and it is then ready for the straightening or finishing machine, Fig. 2.

The heads of this machine are bolted to the cylinder, having hollow bearings, through which the material passes in the process of turning, the cylinder being driven by a gear and pinion.

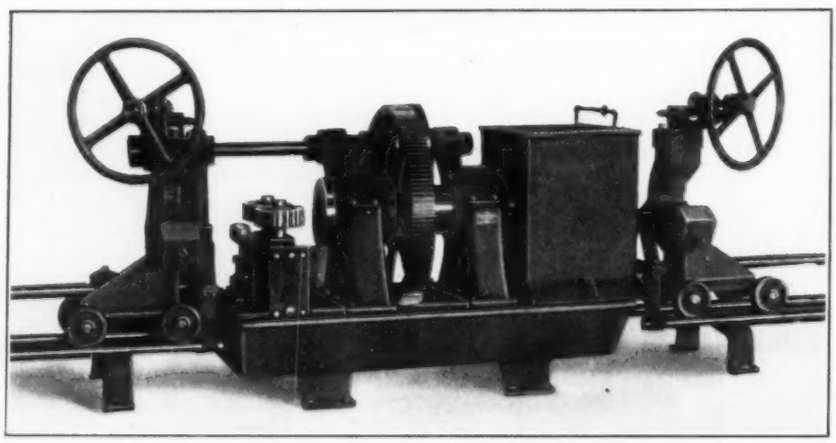


FIG. 1. SHAFTING TURNING MACHINE

The bed of the machine holds a solution of liquid soap, which is continually pumped on the cutters by a small pump in the rear of the machine. Boxes that surround the cutter heads are used for holding chips or turnings. They are so arranged with side openings that they can be readily cleaned while the machine is in operation. At each end of the machine tracks are provided, traversed by a gripping device which will hold material from revolving with the machine. Material as short as 8 feet can be turned, and there is no limit as to the maximum length except the building it is in.

Fig. 2 is for straightening both rough and finished solid bars, steel pipe, bronze rods, tubes, etc. The straightening mechanism consists of three rolls having concave surfaces, the rolls being supported by bearing blocks, having a swivel and screw adjustment. The roll supports are secured to the revolving frame so as to project alternately from opposite sides.

Tracks are provided at each end of the straightener traversed by a gripping device, which holds the material to be straightened from revolving. The contact of the concave rolls in the revolving frame will produce varying speeds according to the amount of concave surface put on the rolls. The certain amount of slipping that is done by the rolls puts on a very fine finish, as well as straightening the work.

FIG. 2. STRAIGHTENING AND POLISHING MACHINE

The rolls are adjusted at an angle to the shaft according to its diameter, and each roll has a segmental line of contact with the shaft. This prevents all gouging out, or breaking of edges of flaws, or cracks which might be found in the surface of the material, and tends to smooth over such flaws and cracks.

A Direct Process for Copying Blueprints

Williams, Brown & Earle, Philadelphia, Penn., are sole licensees in the United States for a new method of making copies from blueprints. This is known as the duplico-process, and consists of brushing a solution over the blueprint, washing it, plunging in a second solution, again washing, and, after drying, making it translucent by a third solution. This gives a negative from which prints of any kind can be made.

A Nut Tapping Machine with a Novel Tap

The nut-tapping machine illustrated was designed by W. M. McKenzie, of 39 Park place, New Rochelle, N. Y., and has several ingenious features which are extremely interesting. The nuts are fed into the hopper *A*, or can be introduced at *B* as desired. From *A* the nuts feed down through a revolving tube in which is a spiral formed by a coiled wire. At *B* is an agitator to prevent clogging. Details of this are shown in the small sketch at the left. They reach the feeding mechanism *C* and are fed to the tap by the cam and finger shown.

The tapping differs from the usual in being continuous, it being unnecessary to remove the tap to take the nuts off. The tap is made longer than usual, and the shank is curved in one plane, as shown in Fig. 2. This is inserted in the holder *D*, which has the same curve, but is enough larger to allow the nuts to pass through. The tap is supported at the start by three or four blank or finished nuts, as shown at *D*. The nuts feed down in front of the tap, are started by the slide, which has an opening behind the tap to allow chips to escape, and start over the tap. The succeeding nuts force those already tapped over the shank and a continuous string of tapped nuts slide over the curved shank and out through the hollow, revolving spindle which drives the tap.

It is a continuous performance, and on ⅝-inch hexagon brass nuts will handle 128 a minute and on a 10-hour run has turned out 50,000 nuts. The method of holding the tap is very ingenious, the curved shank preventing its rotation, but allowing the nuts to pass over it freely.

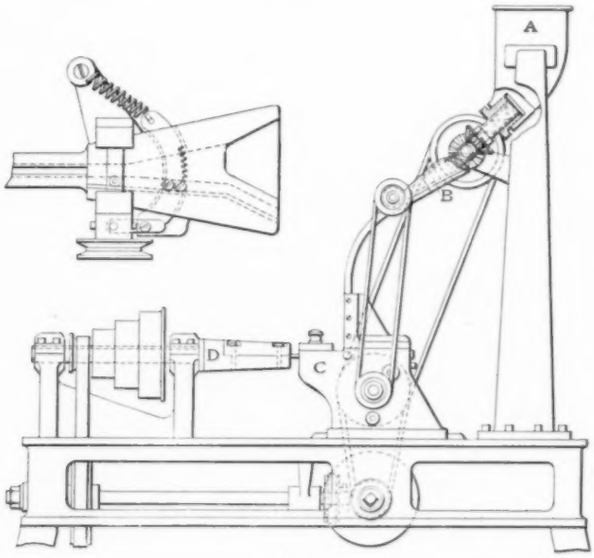


FIG. 1

AN INGENIOUS NUT TAPPER

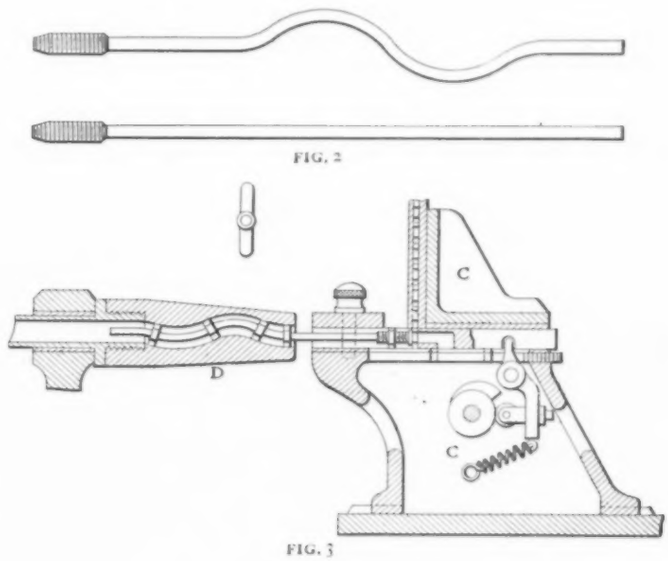


FIG. 2

FIG. 3

THE TAP AND ITS OPERATION

A Portable Grinding Rig

This differs from the usual tool-post grinder in having a portable belt drum which is driven from the lathe cone itself, making the whole outfit self-contained when used on an engine.

The uprights and arms are of 1⅛-inch steel and are easily adjustable as shown in both views, the methods of clamping being clear. The grinder head is adjustabe on the holder which goes in the tool post and is supplied with an extra spindle for internal work. A grinding gage is also supplied. The drum is 9 inches in diameter by 20 inches long and drives the grinder with a 1-inch belt. It is driven

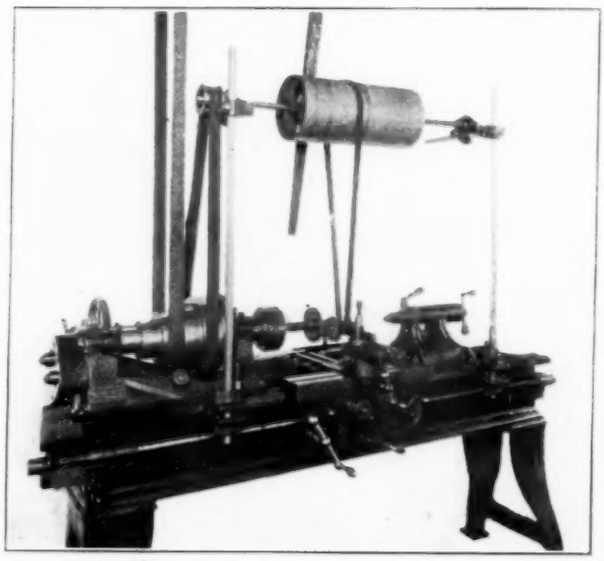


FIG. 1

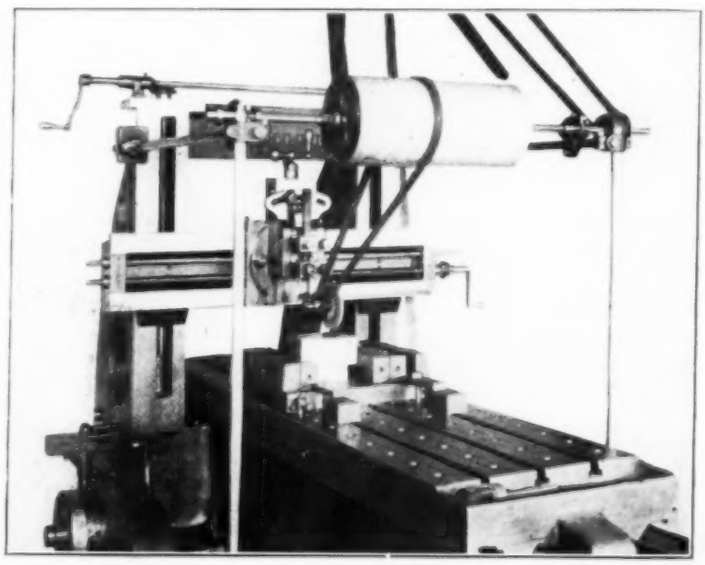


FIG. 2

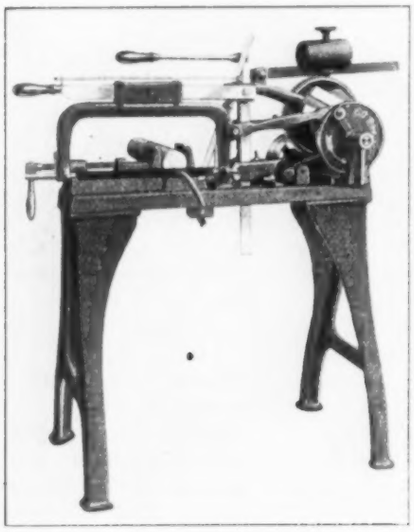
THE PORTABLE GRINDER APPLIED TO BOTH LATHE AND PLANER

from the largest step of the lathe cone by a 2-inch belt. This leaves the other steps to give different speeds to the work being ground. The bearings are of the ball-and-socket type so as to run freely no matter what the adjustment.

Fig. 2 shows the grinder attached to a planer, the drum being driven from a pulley on the countershaft in this case. The drum can be adjusted along the shaft which drives it so as to handle work at different points on the lathe or planer. The attachment is made by the Armstrong-Blum Manufacturing Company, 104 N. Francisco avenue, Chicago, Ill.

Power Hack-sawing Machine

The hack-sawing machine, shown in the accompanying illustration, introduces



POWER HACK-SAW MACHINE

the feature of lifting the saw free from the work on the idle or return stroke, and it has a quick return whereby the idle stroke is made at 80 strokes per minute, whereas the cutting stroke is made at the rate of 40 per minute. The object of the quick-return speed is obviously to increase the capacity of the machine and of the lifting of the blade to increase the life of the saw.

The machine is adapted for the use of 10-, 11-, or 12-inch blades, and it is intended for stock up to 5 inches in diameter, and is fitted with an automatic stop which acts when the cut is finished. It is the product of the Henry G. Thompson & Son Company, of New Haven, Connecticut.

Rotary Indicator for Locating Centers

This indicator has been designed for use in the revolving spindle of a lathe, boring or milling machine, and will show where the work is properly located or how much it is out. Fig. 1 shows the mechanism of the indicator which consists of multiplying levers *A*, *B* and *C*, operated by the movement of the ball-mounted pointer. The end of arm *C* is connected, through the center of the pointer, to the thimble shown, and moves it on the pointer wherever the pointer is moved from the center. Each line on the pointer is 1/32 inch apart, and as it represents 0.001-inch movement, fine indications are easily obtained.

The other illustrations show a number of applications of this indicator to various kinds of work. It is made by A. C. Lindholm, 75 Gregory street, New Haven, Conn.

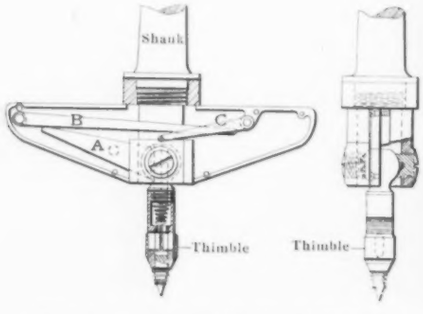
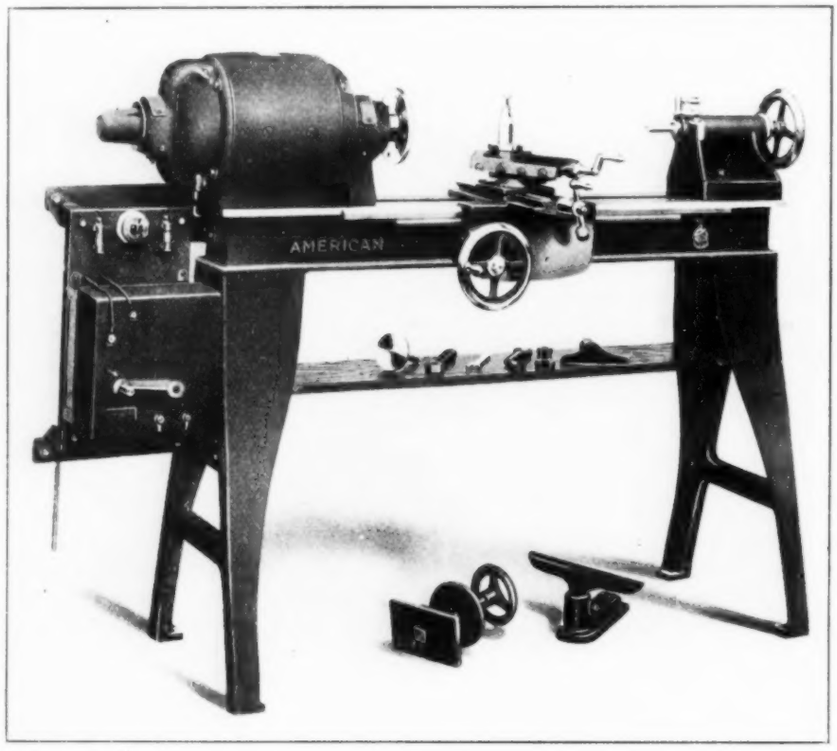


FIG. 1. DETAILS OF ROTARY INDICATOR

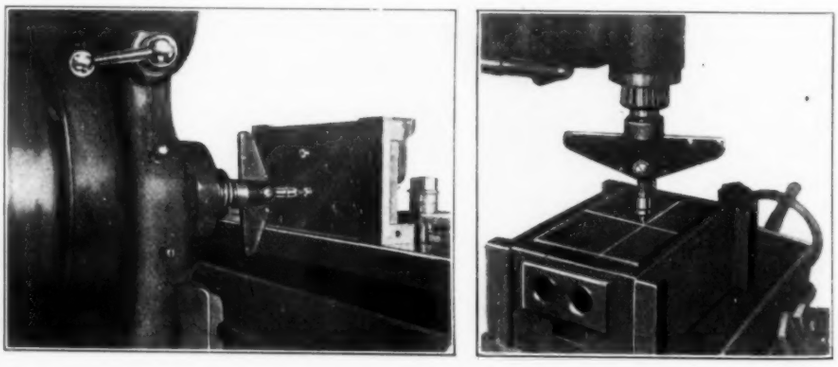
Motor-driven Speed Lathe

This is a 12-inch speed lathe, and is made with both 55- and 72-inch beds, which allow 24 and 39 inches between centers. The main features are the motor-driven head, in which the armature is mounted directly on the spindle with the controlling device at the end of the lathe bed, and the carriage for turning long or taper work.



MOTOR-DRIVEN SPEED LATHE

This is fed by hand and the cross-slide has a compound rest with graduations for any angle. The lathe swings 9 inches over

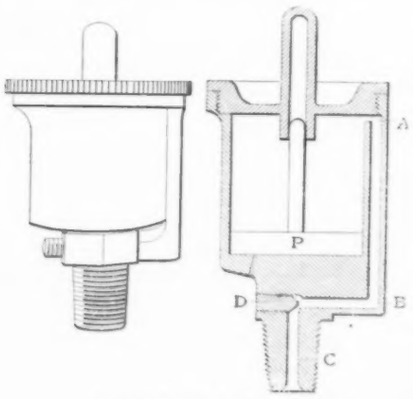


FIGS. 2 AND 3. SOME OF ITS USES

the rest. It is also made with a cone headstock for belt drive, and with this head it will take in 2 inches more between centers than with the motor head. It is made by the American Wood Working Machinery Company, Rochester, N. Y.

Loose Pulley Oil Cup

The loose-pulley problem has always been troublesome and anything that offers a solution is of interest. In this the



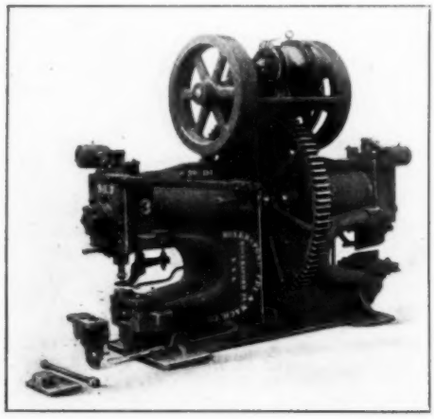
LOOSE PULLEY OIL CUP

oil cup contains a piston *P* which is free to move in its guide. The oil is poured in on top of the piston and the cover replaced. When the pulley starts to run, centrifugal force tends to throw the piston away from the bottom of the cup and oil is forced through the passage *A, B, C* to the hub of the pulley. As soon as the pulley stops the oiling ceases, as there is nothing to force the oil to the bearing, whether the cup stops up or down. If down, the weight of the piston will not force the oil up to the pulley. This is made in two sizes by the Lawson Manufacturing Company, Buffalo, N. Y.

A Punch and Shear

The illustration shows a new line of punching and shearing machinery designed especially for the railroad, boiler and structural shops. The throats on both sides of this machine are made either 26 or 32 inches deep, according to order, and with a 4-inch extension on the punch side, this is increased to 30 and 36 inches, respectively. Each side is independent of the other, or both sides may be operated together. The lower jaw on the punch side is removable, which makes it convenient for punching I-beams and channels.

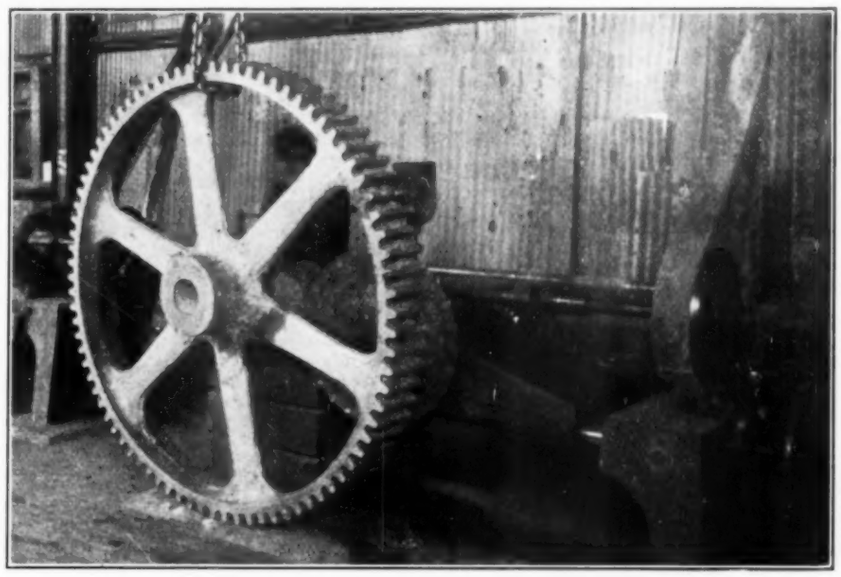
The machine will shear flats 1 inch thick by 10 inches wide, or 2-inch round stock. A hole 1½ inches in diameter can be punched in 1-inch iron. With 26-inch throat the machine weighs 18,000 lb., and with 32-inch throat 21,500 lb. This line of punching machinery is built by the Royersford Foundry and Machine Company, Royersford, Penn.



A PUNCH AND SHEAR

An Unusual Cold Saw Application

The illustration shows an application of the cold saw that is not at all common. It comes from the Duquesne steel foundry at Coraopolis, Penn. The saw is a special design built by the Espen-Lucas Company, of Philadelphia. The size of the gear can be seen by comparing with the man and the machine.



AN UNUSUAL COLD-SAW JOB

There are over 800,000,000 cross-ties in service in the United States according to an estimate made by the Forest Bureau, and it is figured that 100,000,000 were consumed in new track and renewals made during the year 1906. An average life of a tie is but seven years, although with preservative treatment, and an equipment designed to lessen wear, a cross-tie may be made to survive fifteen years. Under present conditions it is estimated that to maintain each tie now in service two trees must be growing.

Japanese Machinery Trade

By Anson W. Richards*

In December of 1905, I was commissioned to make a trip to Japan, and locate there in the interest of American machinery. Having been requested by the American Machinist to write for them a few of my experiences, I shall begin with the trip from San Francisco.

We left San Francisco on the steamship "Korea" of the Pacific Mail Steamship Company, and after six days, arrived in Honolulu—the land of perpetual flowers; a most beautiful spot. As the steamer remained there from nine o'clock in the morning until five o'clock in the afternoon, we all had a good opportunity to drive through the town and see the many beautiful homes, the wonderful aquarium with its tropical fish, etc. When the time came for the steamer to sail, we saw a most beautiful custom, which I understand is observed only at Honolulu. The city band was on the dock, playing the national anthems of all the countries. In the meantime the friends and acquaintances of the passengers had decorated them with strings of flowers, which were hung around their necks. As the steamer leaves, the passengers are supposed to throw the flowers to their friends on the dock, and with the band playing, and everyone shouting good-by and throwing these flowers, it makes a most impressive sight.

We were then off for eleven days more at sea, and the first land to be sighted would be Japan. Fortunately, when we did sight land, it was very clear, and we had a magnificent view of Mount Fuji, snow-capped, and standing out, as it appeared, in the clouds. Mount Fuji is 12,-

*Special Asiatic agent of Manning, Maxwell & Moore, with headquarters at Tokio, Japan.

365 feet high—an extinct volcano—and is the pride of the Japanese nation. Several hours afterward we arrived at Yokohama and landed at the custom-house pier, there to take the native conveyance, commonly called "jinrikisha," to our hotel. This vehicle is a two-wheeled carriage, with room for one person only, and is drawn by a man. It is one of the sights of Yokohama to watch the different expressions of the arriving passengers when they first get into one of these conveyances. Yokohama is divided into three sections—the foreign business section, the foreign residence section and the Japanese section—but in most of the cities of Japan, the foreigners reside and do their business wherever chance may dictate.

Regarding business in Japan in the machinery lines, there is a great field for American machinery, with its acknowledged superiority in many lines, but there is also very keen competition from England and Germany, which American manufacturers should take into consideration when making their prices. Owing to the vast difference in the methods of doing business, the expense and inconvenience of visiting the different sections of the country, and the length of time it takes to close business, I do not think it would pay our manufacturers, with their individual lines, to try to sell for themselves. It is far better for them to combine their interests, so long as the lines do not conflict, being careful, of course, to select a house that will push their interests. My experience is that business there goes to the man who gets after it the hardest, but, of course, his methods have to conform to the customs of the country. It is a mistake for American manufacturers to think they can send their catalog and price list, and the orders will commence to come in with the next mail. On the contrary, it takes long and persistent work to introduce one's line. Send good catalogs and plenty of them; circulars are of no value, except to send out with specific proposals.

All catalogs should give full information regarding gross and net weights, as well as measurements of each piece when packed for shipment, for the cost of freight has to be figured, and the steamship companies reserve the right to take goods by weight or measurement, whichever is the most, figuring forty cubic feet to the ton. The matter of the weight of the pieces is, therefore, of great importance, as the rate increases on heavy pieces, on a graduated scale, so that it is very important to keep the weight and the size of the pieces down as low as possible.

During the trying times of the past months, when our newspapers were full of "jingoism," I found that all the excitement seemed to be on our side. The Japanese were calm, and treated all Americans with their usual perfect courtesy and politeness.

Business Items

The Northern Engineering Works, Detroit, has installed in the Rensselaer Polytechnic Institute, Troy, New York, a No. 30 Newton cupola.

Crocker-Wheeler Company, Ampere, N. J., has received an order for about 2500 horsepower of induction for the Clark Thread Company, of Newark, N. J.

The Philadelphia office of Ridgway Dynamo and Engine Company has been moved from the Girard building to 1017 Witherspoon building. Robt. S. Beecher is manager

The Sprague Electric Company has opened a branch office in the Empire building, Atlanta, Ga. F. V. L. Smith has been appointed manager of this as well as the New Orleans office.

Thos. P. Walls and Chas. J. Bray have formed a partnership under the name of Walls, Bray & Co., and have opened a store at 83 Walker street, N. Y., which will be stocked with a line of machinery, tools and supplies.

Trade Catalogs

Pratt & Whitney Co., Hartford, Conn. Catalog of multiple drills. Illustrated, 28 pages, 9x12 inches, paper.

Western Electric Company, 463 West street, New York. Booklet describing lead covered telephone cable. 10 pages, 3½x6 inches.

The Carpenter Tool Company, Reading, Penn. Catalog describing line of steels and wire and forgings. Illustrated, 138 pages, 4½x6½ inches, paper.

Hanna Engineering Works, 820 Elston Ave., Chicago, Ill. Catalog No. 3, describing pneumatic, hydropneumatic and plain toggle riveters. Illustrated, 64 pages, 6x9 inches, paper.

The Monarch Emery and Corundum Wheel Company, Camden, N. J. Booklet on grinding wheels. Illustrated, 12 pages, 3½x6 inches. Circular illustrating and describing emery wheel dresser.

Emerson Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 3136, single phase induction motors, 1-20 to 1-2 horse power. Bulletin No. 3214, bipolar enclosed motors, 1-20 to 1-2 horsepower. Bulletin No. 3215, bipolar enclosed motors, 1-8 to 1-2 horsepower. Bulletin No. 3505, electric exhaust fans. Illustrated.

Business Opportunities

The plant of the Peoria (Ill.) Foundry Company was destroyed by fire.

The Gardner Printing Company, Cleveland, Ohio., will erect a new plant.

The Interstate Automobile Company, Muncie, Ind., is erecting a new factory.

The Oil City (Penn.) Boiler Works has let contract for a $100,000 addition.

The Pitts-Thompson Company, Dubuque, Iowa, has secured site for a new foundry.

The Virginia Metal Culvert Company, of Richmond, Va., will locate in Roanoke, Va.

The Badger State Tanning Company, Sheboygan, Wis., will erect a four-story addition.

The Central Stamping Company, Newark, N. J., will erect a new building to cost $25,000.

The Louisville & Nashville Railway Company will erect a new roundhouse at Paris, Tenn.

The Gandy Belting Company, Baltimore, Md., will erect a four-story addition to its plant.

It is reported that the Means Foundry Company, Steubenville, Ohio, will erect a new plant.

The Joliet (Ill.) Wheel Company has secured site for its plant and erection will commence shortly.

The Florence (Ala.) Machine Works is erecting an addition to be used as a casting foundry.

The Ohnstrand Metal Furniture Company, Jamestown, N. Y., will erect a five-story addition.

It is reported that the Independent Die Company, St. Louis, Mo., will erect a factory building.

Paper Products Company, Baltimore, Md., has had plans prepared for a new factory building.

The International Nut Company, Niagara Falls, N. Y., has had plans completed for a new factory.

Fire destroyed sawmill No. 1 of the W. H. White Company, Boyne City, Mich. Loss, about $100,000.

The National Wire Cloth Company, Niles, Mich., has secured site on which a new plant will be erected.

It is reported that Armour & Co. are preparing to build repair shops at Meridian, Miss., at a cost of $100,000.

John T. Burriss & Son, Anderson, S. C., manufacturers of metal shingles, will increase capacity of plant.

The St. Paul & Des Moines Railway Company has completed plans for the new shops at Des Moines, Iowa.

The Williams Bros. Boiler and Manufacturing Company, Minneapolis, Minn., is erecting an addition to foundry.

The Standard Box and Lumber Company, Pittsburg, Penn., will erect a branch box factory in Norfolk, Va.

The Goodyear Tire and Rubber Company, Cleveland, Ohio, has had plans prepared for a new factory building.

The Oakland Motor Car Company, Pontiac Mich., has awarded contract for the construction of a new factory.

It is reported that the Kansas City Southern Railway will construct roundhouse and repair shops at Leesville, La.

The cutting mill of the Williamsport (Penn.) Nail Works was destroyed by fire, causing a loss of over $75,000.

The Union Pacific Railway Company will erect a new roundhouse at Cheyenne, Wyo., to replace present one.

The Ontario Knitting Company, Oswego, N. Y., is planning to erect a new plant at a cost of about $300,000.

The Akron (Ohio) Heater Company has been incorporated to manufacture heaters, radiators and stoves.

The plant of the Jenkins Lumber Company, Blaine, Wash., was destroyed by fire, causing a loss of about $500,000.

Plans are being prepared for a two-story planing mill for the Provident Lumber Company, Philadelphia, Penn.

The Clipper Windmill and Pump Company, of Atchison, Kans., will move to Topeka, where a new plant will be erected.

The Edward Hines Lumber Company, Chicago, Ill., will, it is reported, establish several sawmills in Mississippi.

C. W. Hunter, of Meridian, Miss., will establish a plant at Bessemer, Ala., for manufacturing steel and iron furniture.

The Hart-Parr Company, Charles City, Iowa, builders of gasolene engines, will erect a new steel foundry; also power house.

The Automatic Cattle Guard Company, Sandpoint, Idaho, is to shortly erect a plant. Chas. W. Palmer is president.

The Riverside Planing Mills, Columbia, Penn., recently burned, will be rebuilt at once. About $12,000 will be expended.

The Ohio Filler and Shield Company, Columbus, Ohio, will erect a new plant to replace the one recently destroyed by fire.

The B. C. Ames Company, Waltham, Mass., manufacturing precision machinery, has commenced the erection of a new plant.

The plant of the Standard Chain Company at Sarnia, Ont., which was destroyed by a windstorm some time ago, will be rebuilt.

The Root Furniture Company, Shelbyville, Ind., whose plant was recently destroyed by fire, will rebuild on a larger scale.

The Wisconsin & Michigan railway shops, at Peshtigo, Wis., recently destroyed by fire, are to be rebuilt on a larger scale.

It is reported that M. A. Hanna & Company, of Cleveland, are planning to build two large pig-iron furnaces in Buffalo.

The sawmill of the Oregon Lumber Company, at Dee, Ore., was wrecked by an explosion causing a loss of about $50,000.

The Wagner & Wilson sawmill at Monroe, Mich., destroyed by fire some time ago, will be rebuilt at an estimated cost of $150,000.

The foundry and woodenware plant of the Rex Merritt Manufacturing Company, Constantine, Mich., were destroyed by fire.

The Mineral Range Railroad, whose roundhouse at Hancock, Mich., burned some time ago, will replace same with concrete structure.

Fire did $125,000 damage to the plant of the Youngstown (Ohio) Iron and Steel Roofing Company. The burned portion will be rebuilt.

It is reported that the Cambria Steel Company, of Johnstown, Penn., is looking for a site in Cumberland, Md., to locate a rolling mill.

The Savannah Locomotive Works and Supply Company, Savannah, Ga., it is said, contemplates establishing a branch plant in Jacksonville.

The American Car and Foundry Company, St. Louis, Mo., has bought a site, on which it is said a $200,000 factory will be erected.

The Beatrice (Neb.) Iron Works, manufacturers of farming implements, will erect an additional factory building and increase its capacity.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Drawings and tracings made; tools and fixtures designed. Box 638, AMER. MACH.

Wanted—Orders for brass goods. Castings and finished product. Box 601, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Automatic machinery designed. Fred L. Fay, Wilmington, Del.

Blue print expert; black line, negative printer, paper sensitizer. H. R. Guile, Dolgeville, N. Y.

Braze cast iron with Universal Fluxine, $.50 per pound. Universal Fluxine Co., Urbana, Ohio.

Machinery built to order. Up-to-date plant. Write Brunswick Refrigerating Co., New Brunswick, N. J.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Send for circulars and price list of radius gauges, metal tool box and ratchet tap, wrenches. F. G. Marbach, Medina, Ohio.

British patents law. Factory sites between Liverpool and Manchester with water, coal, electric power, railroad, tramcars. Hulton Park, Bolton, England.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Unrefined oil-motors; solvable firm of Budapest is looking for representation of oil-motor factory. Answers are asked sub "oil-motors," care Rudolf Mosse Advertising Office, Budapest, Hungary.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

I have a very good improvement in "thread intercutting tool;" will give one-half interest to right party. Inventor wishes also to take out foreign patents. Robt. Klotz & Co., Patent Attorneys, 911 Schiller Bldg., Chicago.

Cost reducing machinery designed and built. Guaranteed per cent. on investment. Send sample or sketch of work and cost of manufacture. Remington M'f'g Co., Fitchburg, Mass.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

COLORADO

A-1 designer and draftsman desires position. Box 618, AMERICAN MACHINIST.

CONNECTICUT

First class tool and die maker; can produce best results; 12 years' experience. Exceptionally good recommends. Now employed as foreman in large concern; wishes change. Box 630, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—Position as special machine designer. Box 627, AMERICAN MACHINIST.

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 620, AMERICAN MACHINIST.

Superintendent, young man, energetic, aggressive, understands thoroughly the making of cast brass goods; familiar with moulding machines, metal patterns and core boxes; monitors, polishing, plating, cock making, tools, jigs and fixtures for production of interchangeable parts. Up-to-date methods of handling help and getting work out rapidly, at small cost of production. Box 629, AMER. MACHINIST.

NEW JERSEY

Mechanical draftsman wishes position. Address Box 636, AMERICAN MACHINIST.

Thirteen years an executive on tools and manufacturing, designing methods and tools. Reducing costs, practical and thorough, broad experience, modern. Best references. Box 622, AMERICAN MACHINIST.

Young man has had eight years' experience in designing, proportioning, testing and adjusting of high duty pumping engines, either Corliss, flywheel or direct-acting type. Box 628, AMERICAN MACHINIST.

Lehigh graduate mechanical engineer, 11 years' experience as designer, chief draftsman and superintendent developing automatic machinery. Inventive ability and competent to take charge. Will accept any position with future. Box 624, AMERICAN MACHINIST.

NEW YORK

Automatic screw maker. Box 613, AM. MA.

Draftsman of experience seeks position. Box 626, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, experienced; best references. Box 633, AM. MA.

Draftsman, graduate M. E., three years' drafting experience, wishes position. Box 634, AMERICAN MACHINIST.

Designer, age 32, technical graduate, All around mechanical work, checking, estimating. Box 619, AMERICAN MACHINIST.

First class draftsman, technical education, Corliss, high speed or gasolene engines, wants position. Box 632, AMERICAN MACHINIST.

Draftsman, experienced marine and stationary, pumping, refrigeration machinery, desires position; 35 years. Box 604, AM. M.

Technical, graduate from "Technikum *Winterthur*" (Swiss) Institute. Age 21, wants position as mechanical draftsman. Eastern states. Box 635, AMERICAN MACHINIST.

Draftsman, competent mechanical, technical graduate, 28, with five years' experience, wants position. Salary upon merits. "Capable," 22 East 4th St., New York City.

Draftsman, six years' varied experience, including automatic machinery; also three years' practical shop experience. Technical education; best references. Box 625, AM. MA.

Designer, age 31, graduate engineer, wide experience special, automatic and fine machinery, experimental design, tools, fixtures; very able man; location immaterial. Box 605, AMERICAN MACHINIST.

First class mechanical draftsman and designer wants situation in New York City. Special machinery or automobile work preferred. Salary $21.00 per week. Best references. Box 592, AMERICAN MACHINIST.

Draftsman, with 14 years' shop and office experience, locomotive design, special work, systematic rearrangement of equipment in machine, boiler shops, etc., to reduce unapplied labor and increase output. Box 506, AMERICAN MACHINIST.

Superintendent or general manager, 20 years' experience in machine shop, gray iron and brass foundries; largely hand, triplex power and steam pumps; designing, manufacturing and selling. American, technical graduate, practical, executive; very successful in reorganizing and modernizing for low cost production. Address Box 585, AM. MACH.

PENNSYLVANIA

Designer, skilled in originating and developing special and automatic machinery and overlooking construction; expert in printing and numbering machinery. Box 637, AMERICAN MACHINIST.

Successful sales manager of railway and industrial supplies, with extensive selling experience in nearly all parts of United States and Canada, desires change. Would like to engage with high class company in sales or purchasing department. Age 31. Box 623, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—Competent draftsman with experience on power presses. State reference, age and salary expected. Box 615, AMER. MACH.

Wanted—A vise or bench hand for tool work. One who is experienced in die sinking preferred. Application must state age, experience in detail, references and salary required. H. Mueller Mfg. Co., Decatur, Ill.

A prominent Chicago machine tool merchant desires to engage the services of three first class salesmen of established ability who are well and favorably known to the Middle Western trade. Box 631, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—A first-class toolmaker on punches and dies. Address, with references and wages required, Box 612, AMERICAN MACHINIST.

Wanted, tool makers and machinists, accustomed to valve and steam fitting work, also man capable of taking charge of about 50 men. District about 100 miles east of New York. Reply, stating age, experience and wages required, to Box 611, AMERICAN MACH.

NEW JERSEY

Draftsman Wanted—First-class draftsman familiar with printing machinery. Must be capable of designing. State fully experience, age and salary wanted. Box 617, AMER. MACH.

Salesman Wanted—A first-class printing press salesman familiar with flat-bed and large rotary presses. Must have traveling experience. State full information regarding previous employment, age and salary wanted. Box 616, AMERICAN MACHINIST.

NEW YORK

Wanted—Agents to sell American Machinists' Handbook; money-making proposition. Write Book Department, Hill Publishing Company, 505 Pearl St., New York.

Wanted—Patent office draftsman familiar with electrical work, for steady position with reliable concern in New York City. State age, experience and salary expected. Box 598, AMERICAN MACHINIST.

Wanted—Works manager or superintendent of manufacturing plant, employing about 1000 men. Experienced machinist having thorough knowledge of up-to-date methods

and ability to organize each department and the shop in general. An A-1 man in every respect is wanted and will find the work and the salary attractive. Box 614, AM. MACH.

PENNSYLVANIA

Wanted, Shop Superintendent—Man of wide experience in organizing work. Must be a systematizer and thoroughly familiar with modern methods of production along the lines of finishing small iron and brass castings and light sheet metal work. To the right man an invaluable opportunity is open to grow with a young progressive concern. Reply in own handwriting, giving age, experience, reference and salary expected. Box 621, AMERICAN MACHINIST.

For Sale

For Sale—Engine lathe, 17 inch swing, 40 inches between centers. Wanted, small shaper. Chas. W. Snyder, 534 Washington St., Hudson, N. Y.

For Sale, absolutely new, a No. 2½ heading machine and a No. 2½ reheading machine. Waterbury-Farrel make, never used. Ohlen Company, Box 740, Columbus, Ohio.

For Sale—Tracings, patterns, jigs and templets for the following size gas and gasolene engines: 1½, 3 and 5 horsepower vertical and 3, 5, 8, 10, 12, 16 and 20 horsepower horizontal; also a number of finished and unfinished engines of the above sizes. All of the above sizes have been in successful operation for several years. This is a splendid opportunity for anyone wishing to build gas or gasolene engines. You can save thousands of dollars in experimental work by purchasing this complete outfit. Shop rights of valuable patents on these engines will be given to purchaser. Box 366, AMERICAN MACHINIST.

Land for sale for building purposes for the erection of works, etc., in Manchester, England, and its immediate neighborhood, convenient for railway and canal traffic. Full information from the Hon. John E. Cross, Land Agent, High Legh, Knutsford, England.

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